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A Manual of Poisonous Plants

Chiefly of Eastern North America, with Brief Notes on Economic and Medicinal Plants, and Numerous Illustrations

By

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PART II

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A. Rhododendron, Hydrangea in a Maryland forest. (After Shreve, Chrysler, Blodgett and Besley, Maryland Weather Service).

B. Mountain Laurel, Rhododendron in a hemlock forest in Maryland. (After Shreve, Chrysler, Blodgett and Besley, Maryland Weather Service).

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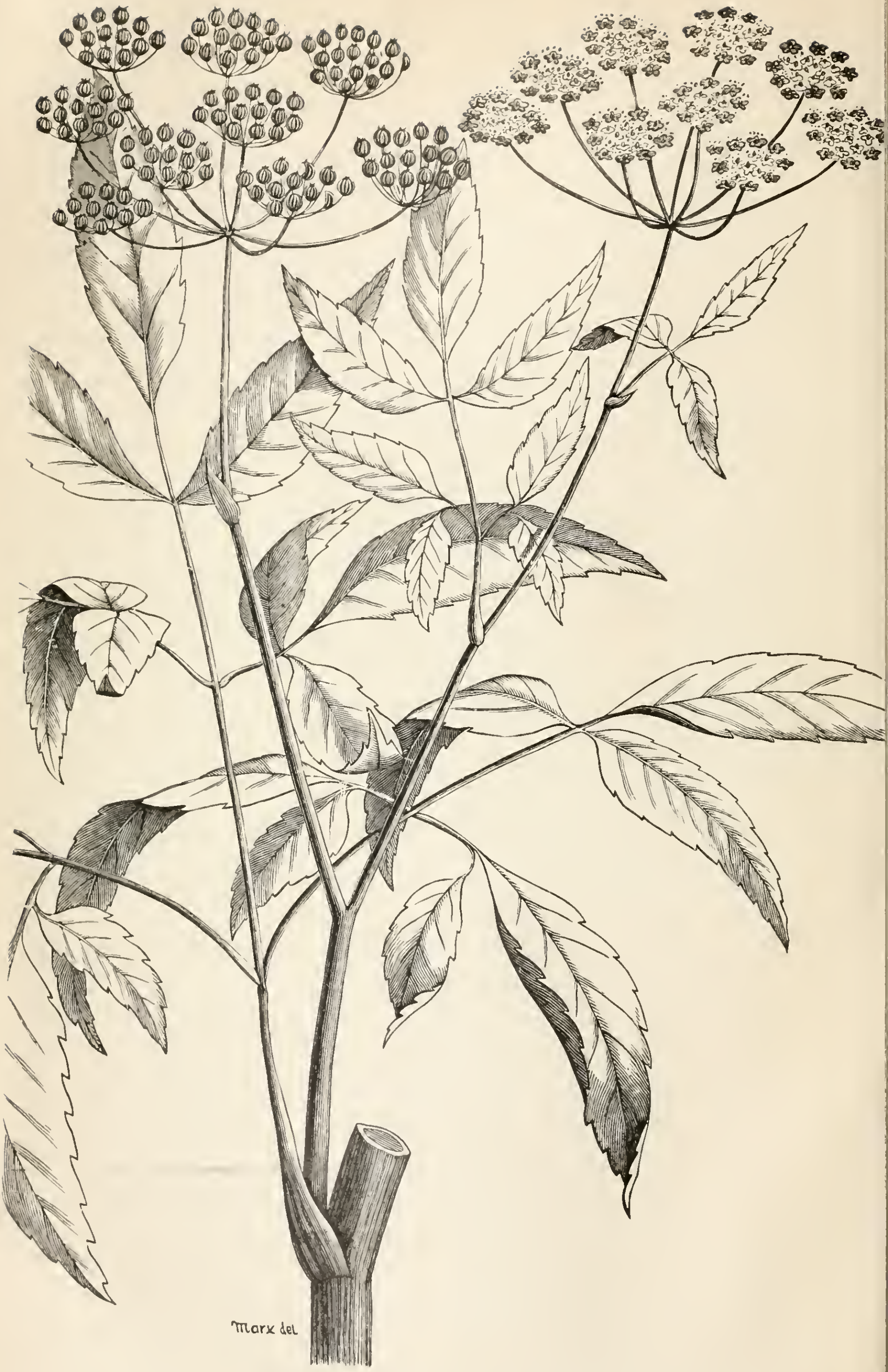

Cowbane—Very Poisonous. (After Vasey)

KEY FOR THE PLANT KINGDOM

Organisms without chlorophyll, the vegetative body a naked mass of protoplasm with many nuclei; reproduction asexual, spores free or enclosed in sporangia; spores produce motile swarm spores or amoeboid bodies. A. *Myxothallophyta.* 158

Cells generally with cell membrane, with one or more generations; sexual reproductions frequently absent, the fertilized spores when present with one cell, which later separates from the mother plant, or a several celled body resulting from the fertilization of the female fructifying body, which later develops into a new plant. B. *Euthallophyta.* 160

Small unicellular organisms, never green but frequently of other colors, blue greens, etc.; reproduction asexual by fission; spores formed in the interior of the cell or by transformation of vegetative cells into the endospores or arthrospores; nuclei absent, but a so-called "Central body" occasionally present; coloring matter equally distributed. I. *Schizophyta.* 160

Unicellular organisms generally colorless at least never green; membrane, consisting of a chitin-like substance, occasionally gelatinous; cells frequently with cilia; reproduction by fission; spores when present endospores or arthrospores. *Schizomycetes.* 161

Unicellular organisms like the preceding, cells contain chlorophyll and phycocyanin consisting of blue, blue-green, violet, or reddish pigments; swarm spores absent. *Schizophyceae.* 184

One-celled organisms with nucleus sharply differentiated; protoplasmic body with a simple denser protoplasmic membrane, pseudopodia absent, motile during most of their existence; cilia 1 or more, and with 1 or 2 pulsating vacuoles; chromatophores occasionally absent; reproduction asexual by longitudinal division. II. *Flagellatae.* 188

Plants occurring mostly in water, always with cell-membrane and nucleus; green or other colors (brown or red) mixed with the green. III. *Euphyceae.* 188

Small unicellular organisms occasionally forming chain-like colonies. Cells possess two long cilia which arise from a furrow in the ventral surface. Found mostly in the plankton of salt water. *Peridinales.* 188

Small one-celled organisms of brown color, the chlorophyll masked by diatomin found in chromatophores; cell-wall consisting of silica with a girdle and fine lines; reproduction asexual; division parallel to the long axis of the organism, and the formation of auxospores and sexual, by the formation of auxospores by conjugation. *Bacillariales.* 188

Chlorophyll green algae; membrane without silica; reproduction by division, swarm cells absent; sexual reproduction by zygospores through the union of two equivalent gametes. (Aplanogametes). *Conjugatae.* 189

Chlorophyll green plants, occurring singly or in colonies (threads or flattened bodies); one or more nuclei, reproduction asexual by producing multilateral zoospores and nonmotile aplanospores; sexual by the copulation of zoogametes, or spermatozoids and oospheres; the spores produce a new plant directly or generally produce swarm spores. *Chlorophyceae.* 190

Plants of brackish or fresh water, consisting of internodes, short whorls of cylindrical branches, cells nucleated; growth from an apical cell; asexual reproduction by means of bulbils and vegetative threads; sexual reproduction by egg-cells and spermatozoids, the latter are spirally coiled in the cells of the antheridium; the egg cell is contained in a spirally coiled structure and after fertilization becomes an oospore. *Charales.* 193

Brown algae, chlorophyll masked by a brown coloring matter, phycophaein; reproduction sexual and asexual, swarm spores, sperm cells and egg cells; marine; tetragonidia absent. *Phaeophyceae.* 194

Brown algae; reproductive bodies without motion; tetragonidia present. *Dictyotales.* 194

Red or violet algae; chromatophores contain chlorophyll and a red coloring matter (phycoerythrin and rhodophyll); reproduction sexual and asexual; mostly marine. *Rhodophyceae.* 194

Parasitic or saprophytic plants with one or more cells, chlorophyll absent, with apical growth; mycelium usually evident; reproduction sexual and asexual, generally the latter; asexual by the formation of zoospores, conidia or spores. IV. *Eumycetes.* 195

The vegetative body mostly 1-celled, tubular, asexual by the formation of spores or endospores sexual by the formation of zygospores. *Phycomycetes.* 195

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Mycelium, many celled; reproduction asexual or sexual by union of nuclei; conidia borne on basidia, number various. *Basidiomycetes.* 209

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Fungi whose spores are not in sacs, or consist of sterile mycelium. Forms like *Oidium, Ozonium,* or *Mycorrhiza.* *Fungi Imperfecti.* 281

Organisms consisting of a fungus and an alga. Spores either in sacs (*Ascolichenes*) or borne like toadstools (*Hymenolichenes*). *Lichenes.* 307

Plants with stem, root and leaf; cormophyte or in some cases thalloid. Two generations, gametophyte and sporophyte; antheridium with sperm cells; tube cell absent. C. *Embryophyta Zoidiogama.* 308

Many celled differentiated structure frequently with leaves and stem or thalloid in some cases. Male (antheridium) and female (archegonium) organs are produced. Asexual spores in spore cases which open at the top, in true mosses. I. *Bryophyta.* 308

Spores alike or unlike, microspores and macrospores developing into flat or irregular prothallia; these bear the reproductive organs, (antheridia and archegonia); flowers and seeds absent; usually a well developed vascular system. II. *Pteridophyta.* 312

Plants with a microsporangium (anther) containing the microspores (pollen grains) which develop a tubular body, the prothallium (pollen tube) a macrosporangium (ovule) containing the macrospore (embryo-sac) which develops into a minute prothallium; this remains enclosed in the macrosporangium; after the fertilization of the egg cell in the macrospore a seed develops; plants with flowers and usually well developed tissues, the epidermis, parenchyma and vascular. (*Embryophyta Siphonogama*). D. *Spermatophyta.* 325

Ovules not enclosed in an ovary. I. *Gymnospermae.* 325

Resinous trees or shrubs; wood with tracheids, tracheae usually absent; fruit a cone of dry or fleshy scales. *Coniferae.* 327

Ovules enclosed in an ovary. II. *Angiospermae.* 332

Embryo with 1 cotyledon; stem without distinction into pith, wood, and bark; endogenous; leaves usually parallel veined; flowers generally on the plan of 3. 1. *Monocotyledonae.* 332

Flowers generally small, unisexual, regular with persistent perianth; 6 or 3 stamens; carpels free or rarely united; fruit a berry, drupe or nut; embryo small; endosperm copious. *Principes.* 369

Palm-like plants with palm-like leaves; flowers naked or with thick leaves of perianth; carpels 2 or 4 with 2 or 4 placentae. *Synanthae.*

Mostly fleshy herbs or thalloid floating plants; inflorescence a fleshy spadix subtended by a spathe or naked or reduced to few or solitary flowers on the margin or back of a thalloid body. *Spathiflorae.* 370

Herbs generally with narrow leaves; flowers usually complete, their parts mostly on the plan of 3; corolla regular or nearly so; ovary compound superior; endosperm mealy. *Farinosae.* 372

Mostly herbs; flowers with a well developed perianth, usually regular and complete; usually on the plan of 3; ovary superior or inferior, compound; endosperm fleshy or horny. *Liliiflorae.* 374

Large herbs; flowers irregular; ovary inferior, compound; composed of several united carpels; seeds generally arillate, frequently with perisperm and endosperm. *Scitamineae.* 390

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Dicotyledonous herbs; petals and sepals absent; flowers small spicate with bractlets. *Piperales.* 396

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Trees or shrubs; leaves simple; flowers small, monoecious or dioecious, in catkins; perianth absent; ovary 1-celled; style short; stigmas 2; endosperm none. *Myricales.* 397

Woody plants with simple leaves; flowers, staminate spicate, pistillate solitary. *Balanopsidales.* 399

Shrubs or trees; flowers small, dioecious, in catkins; leaves simple, alternate, petioled, perianth absent in staminate flowers; pistillate, subtended by bractlets; ovary 1-celled; endosperm thin. *Leitneriales.* 400

Trees with alternate, pinnately-compound leaves; flowers monoecious, with bractlets, staminate in catkins, pistillate, solitary or several; ovule solitary, erect; fruit a drupe, indehiscent or dehiscent, with woody husk, seed large 2-4 lobed; endosperm none. *Juglandales.* 400

Trees or shrubs; flowers small; calyx usually present; monoecious, or rarely dioecious, in catkins; pistillate flowers subtended by an involucre which becomes a bur or cup in fruit. *Fagales.* 402

Shrubs, herbs or trees; calyx present but corolla absent; flowers small, not borne in catkins, monoecious, dioecious or polygamous; ovary 1-celled superior. *Urticales.* 404

Shrubs, trees or herbs with scattered leaves; flowers in spikes, racemes or panicles usually perfect; single carpel. *Proteales.* 415

Herbs or shrubs; generally parasitic; calyx present; corolla absent; flowers perfect, or imperfect; a single inferior ovary; fruit various. *Santalales.* 415

Generally vines or herbs; leaves cordate, or reniform; corolla absent; calyx inferior; tube wholly, or partly adnate to ovary; flowers perfect. *Aristolochiales.* 416

Generally herbs, occasionally trees, shrubs or twining vines; leaves simple, mostly entire; flowers small, regular, perfect, dioecious, monoecious or polygamous; petals absent; stamens 2-9; filaments filiform or subulate; ovary superior one-celled; ovule solitary; fruit an achene; endosperm mealy. *Polygonales.* 417

Generally herbs, occasionally shrubs; flowers perfect; corolla usually absent, when present polypetalous; calyx present; ovary superior; embryo coiled curved or annular; albumen present. *Centrospermae.* 423

Herbs, shrubs or trees; calyx usually of separate sepals; corolla generally present, polypetalous; ovary superior; carpels many usually separate; stamens generally free and more numerous than sepals. *Ranales.* 444

Generally herbs; flowers regular and perfect; petals generally separate; stamens free; ovary compound, superior; free from calyx. *Rhoeadales.* 479

Carnivorous plants; flower scapose; corolla with separate petals or nearly so sepals generally distinct; stamens free; ovary compound superior. *Sarraceniales.* 497

Herbs, shrubs or trees; usually with petals which are separate; stamens generally perigynous or epigynous; sepals generally united or confluent with receptacle which is concave; carpels 1 or more distinct or united into a compound ovary. *Rosales.* 498

Trees, shrubs, or herbs; usually with petals which are separate,, united in some or entirely wanting; sepals mostly distinct; stamens few or occasionally more than twice as many as the sepals; alternate or opposite with them; ovary compound, superior. *Geraniales.* 574

Trees, herbs or shrubs; petals usually present and separate; sepals generally distinct; stamens opposite usually fewer than sepals or as many, occasionally more than twice as many; ovary superior, compound; ovules pendulous. *Sapindales.* 604

Shrubs, small trees or occasionally vines; leaves generally alternate; flowers, small, regular; stamens as many as sepals or calyx lobes alternate or opposite with them; ovary compound superior; ovules erect. *Rhamnales.* 620

Trees, shrubs or herbs; leaves simple, mostly alternate; flowers regular, usually perfect; sepals separate, or more or less united; petals separate, or wanting; stamens usually numerous; ovary superior, compound; disk inconspicuous or none. *Malvales.* 621

Shrubs, trees or herbs; flowers generally complete, perfect, and regular or irregular in some; sepals distinct, or more or less united; petals almost always present and distinct; stamens usually numerous; ovary compound, superior; placentae mostly parietal. *Parietales.* 627

Fleshy plants, leafless, or with small leaves, generally spiny; flowers mostly solitary, sessile, regular, perfect and showy; calyx tube adnate to ovary; limb many-lobed; petals numerous; stamens numerous; ovary 1-celled; ovules numerous; fruit a berry. *Opuntiales.* 634

Shrubs, trees or herbs; leaves simple; petals usually present and distinct; calyx 4-5 lobed or entire and petals wanting in Thymeleales, superior or inferior; ovary 1 or more celled; ovules 1 or numerous. *Myrtiflorae.* 637

Herbs, shrubs or trees with petals; leaves of calyx usually 5; stamens 4 to 5; ovary epigynous, adnate to calyx; ovule, 1 in each cavity. *Umbellales.* 645

Petals partly or wholly united rarely separate or wanting; coherence variable in some cases; tubular or funnel-form. (Sympetalae or Gamopetalae). b. *Metachlamydeae.* 664

Flowers complete, regular with lobed or distinct calyx; corolla cleft gamopetalous; stamens free from corolla; ovary compound. *Ericales.* 664

Mainly herbs; corolla gamopetalous; calyx generally free from ovary; stamens borne on corolla, as many as its lobes, or twice as many, or more. *Primulales.* 675

Trees or shrubs; alternate, simple leaves; flowers generally regular; calyx free from ovary, inferior; corolla gamopetalous or polypetalous; stamens borne on tube, at base of corolla. *Ebenales.* 679

Trees, shrubs, herbs or vines, generally with opposite leaves; flowers regular; corolla generally gamopetalous, or rarely polypetalous or wanting; stamens borne mostly in lower part of corolla, as many as lobes or fewer, alternate; ovaries 2 and distinct. *Contortae.* 670

Rarely trees, shrubs, generally herbs; corolla nearly always gamopetalous, regular or irregular; stamens adnate to corolla tube; ovary one, superior compound. *Tubiflorae.* 698

Herbs frequently acaulescent or caulescent with opposite or alternate leaves; flowers small, perfect, polygamous or monoecious; calyx 4-parted; corolla free; stamens 2 or only 1; ovary sessile, superior, 1-2-celled or falsely more celled; fruit a pyxis. *Plantaginales.* 739

Plants with gamopetalous corolla; stamens as many as corolla lobes; and alternate with them, or occasionally fewer, or twice as many; ovary compound inferior, adnate to calyx tube or ovary 1 or more celled; ovules 1 or more in each cavity of ovary; leaves opposite or verticillate. *Rubiales.* 740

Herbs or rarely shrubs with gamopetalous corolla or occasionally petals separate; stamens as many as corolla lobes or fewer; anthers generally united; ovary inferior. *Campanulatae.* 748

MYXOTHALLOPHYTA

Fungus-like organisms without chlorphyll, regarded by some as animals; intermediate, in some respects, between animals and plants and hence called Mycetozoa by Rostafinski. In their vegetative condition, they consist of naked masses of protoplasm with many nuclei, the mass of protoplasm being called the plasmodium which creeps about on the substrata changing in form and thrusting out processes called pseudopodia which may later coalesce. After

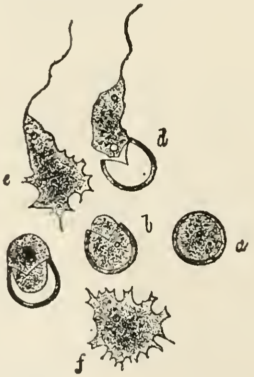

Fig. 20. Slime Mould (*Trichia varia*). a. Before germination. b, c, d. Different stages in germination. d, e. Amoeboid body with flagellum. After DeBary.

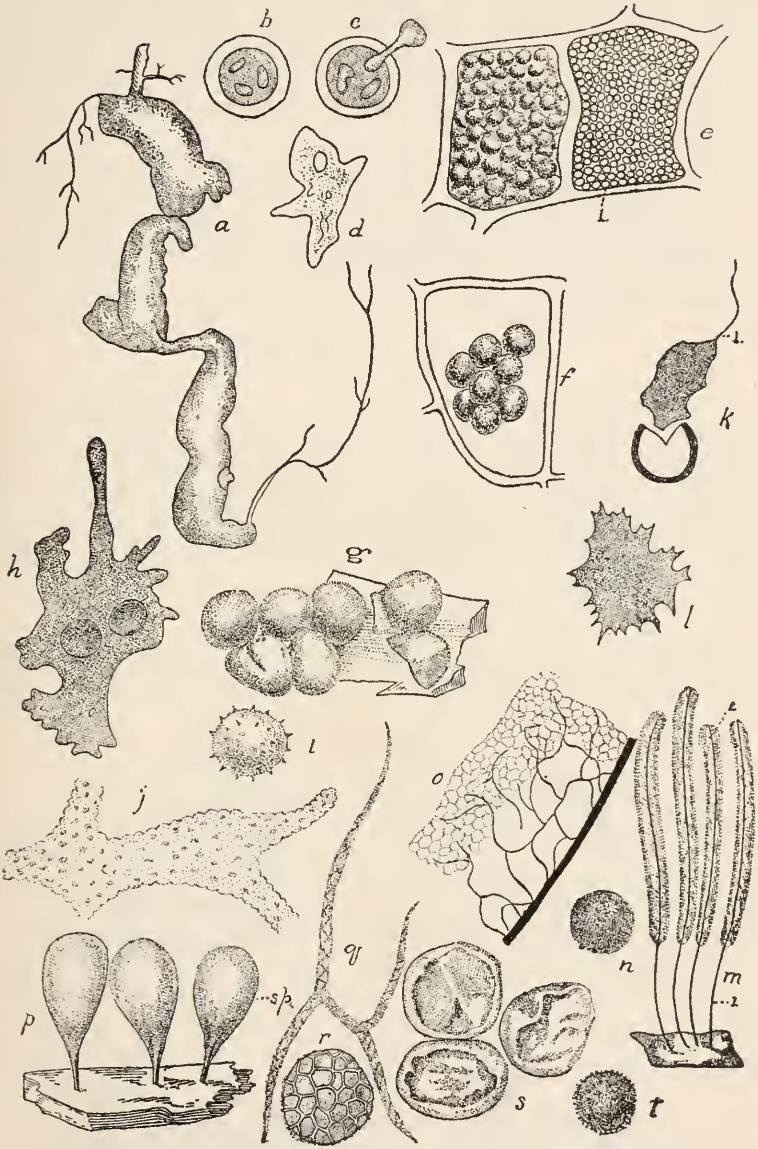

Fig. 18. Various slime moulds. *a—f.* Club root of Cabbage; *Plasmodiphora Brassicae*: *a.* Swollen root; *b.* Spore; *c.* Spore germinating; *d.* Plasmodium; *e.* Cells showing aggregated masses; *f.* Spores in cells; *g. Lycogola epidendron*; *h, j.* Plasmodium with branches; *i.* Spore; *k.* Spore germinating showing cilium; *m. Stemonitis*; 1. Stipe; 2. Columella; *o.* Capillitium; *p. Trichia decipiens*; *sp.* Sporangia; *q.* Elater; *r.* Spore.

a shorter or longer period the protoplasm contracts forming little heaps which contain the spores; the parts of the reproductive body are called the *sporangium* or spore case, the *peridium* or the wall of the case, the *stipe* or stalk, the *columella* or central axis in the spore case, the *capillitium* or fine threads, and the *spores.* The spores after absorbing water, germinate by breaking the wall and move about by means of cilia; sexual reproduction is entirely absent.

The division Myxothallophyta includes three classes: *Acrasieae* without swarm cells; *Plasmodiophorales* of which the club root of Cabbage, *Plasmodiophora Brassicae* is an example (a very destructive parasite upon cabbage, turnip, etc., in Europe and the Eastern States); and *Myxogasteres* which contains a great many species and genera common on spent tan bark, rotten logs, and the ground. Of the third class *Stemonitis, Physarum, Lycogola* and *Fuligo* are common genera. No species of this class is poisonous so far as known.

EUTHALLOPHYTA

Cells generally with cell membrane, with one or more generations, sexual reproduction frequently absent, the fertilized spores when present, with 1 cell which later separates from the mother plant, or a several-celled body resulting from the fertilization of the female fructifying body, which later develops into a new plant. This division includes such plants as bacteria, blue green algae, the green algae, rusts, smuts, mildews, moulds, puffballs, mushrooms and toadstools.

SCHIZOPHYTA

Small unicellular organisms, never green but frequently of other colors, blue greens, etc., reproduction asexual by fission, spores formed in the interior

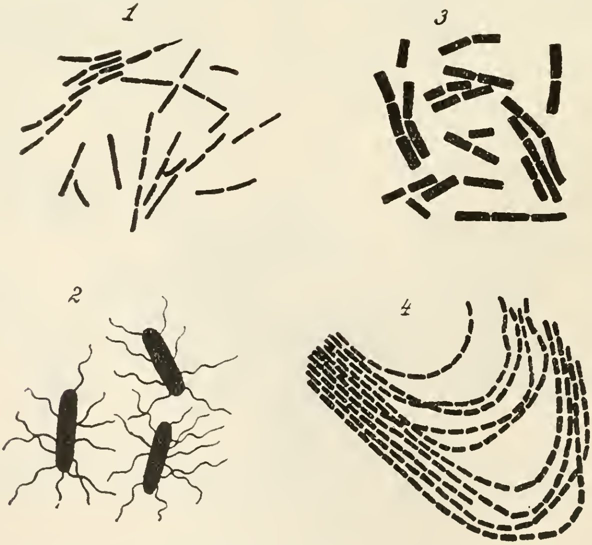

Fig. 19. Schizophyta. Schizomycetes Bacteria. 1 and 2. *Bacillus subtilis* 3 and 4. *Bacillus anthracis.* 1, 3 and 4x1000. 1, 3, and 4 after Fränkel and Pfeiffer. 2 after Migula.

of the cell by the transformation of vegetative cells into endospores, or by the transformation of ordinary vegetative cells into arthrospores; nuclei absent, but a so-called "central body" occasionally present; coloring matter equally distributed. This sub-division includes the Bacteria or Schizomycetes and the Blue-green Algae or Schizophyceae.

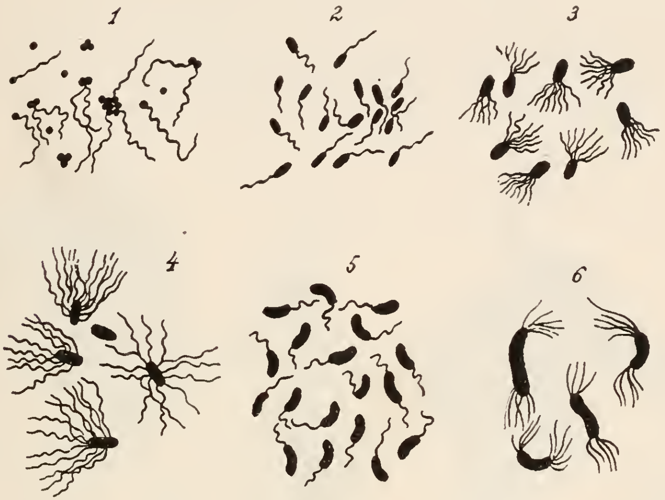

Fig. 20. Schizophyta. Shizomycetes. Bacteria with flagellae. 1. *Planococcus citrus* 2. *Pseudomonas pyocyanea.* 3. *Pseudomonas syncyanea.* 4. *Bacillus typhi.* 5. *Spirillum comma.* 6. *Spirillum rubrum.* Fig. 1-6x1000; all after Migula.

SCHIZOMYCETES

Schizomycetes is one of the two classes of the sub-division Schizophyta. All the members of this sub-division are characterized by having no known sexual method of reproduction, multiplying by means of simple fission or cell division. The bacteria are distinguished from the first, or Schizophyceae, by the absence of the blue-green coloring matter which is characteristic of these forms. The two sub-divisions approach each other very closely at some points, particularly among the branched bacteria. The shape of the bacteria is used as the character in the separation of the families. They are either rod-shaped, and unbranched, spherical, bent, or spiral and straight and branched, and with or without sheathing, covering, or membrane. Five families are distinguished by Migula. Some of these contain considerable numbers of bacteria important from their toxigenic properties.

Bacteria are among the smallest of living beings, some undoubtedly being so small that they cannot be seen with the highest powers of the microscope. Others are large enough so that they may be seen as minute specks by the naked eye. In other words, they vary from less than 1/10 μ to 100 μ. They may be arranged in the case of the rod-shaped forms or bacilli, either singly or in chains. The same is true of the spirilla, or spiral forms. The cocci or spherical forms may be single, in pairs, in regular mass of 4 and multiples of 4, in chains, in irregular clusters, or imbedded in gelatinous mass forming zoogloeae. Multiplication, as before stated, is by simple fission or cell division. Growth takes place very rapidly in many forms, some being capable of growing to their full size and dividing to form two individuals in twenty minutes to half an hour. Under favorable conditions, this rapidity of multiplication explains the importance of the results obtained, and the products formed from such small plants. Some forms are capable of moving or swimming about by means of whips or flagella placed on all sides or simply at the ends. Other forms move by a sinuous or snake-like bending of the body. Many forms are incapable of motion. Spores are formed by many species; they are called endospores when formed singly within the bacterial cell, and arthrospores when formed by increase in size of the cells of the filament or part of a filament and its splitting into a

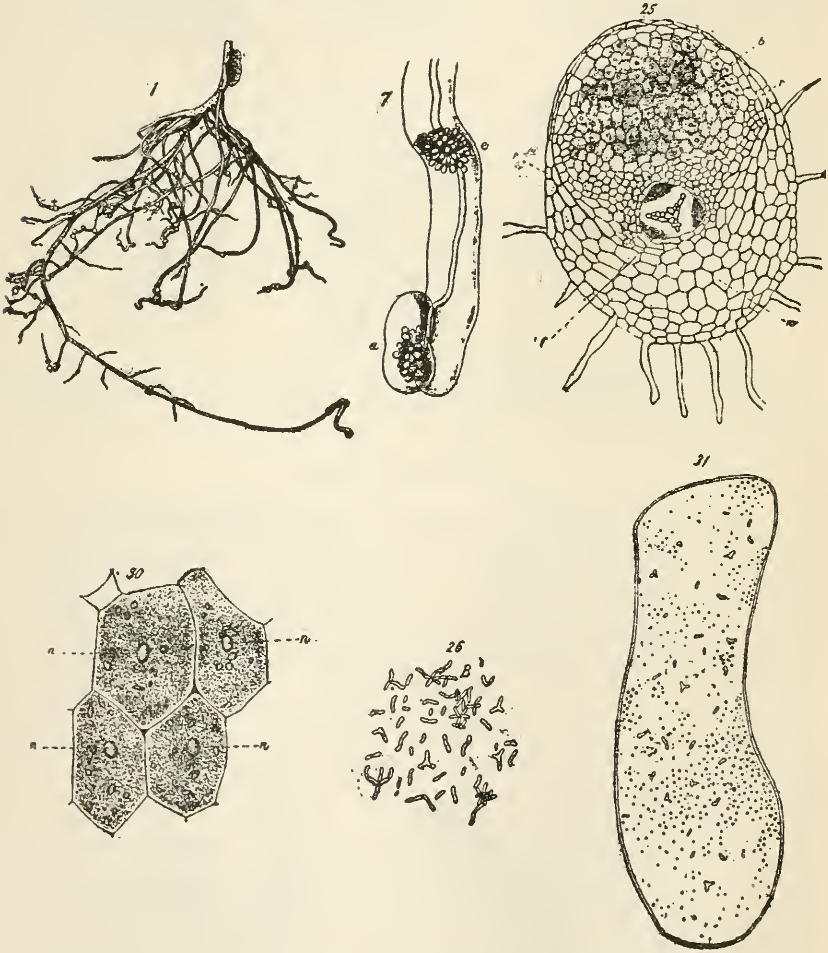

Fig. 21. The root tubercle organism (*Rhizobium leguminosarum*). 1. General view of root showing tubercles. 7. Root hair and strand with enlargements at *a* and *e*. 25. Cross-section of root at *b* bacterial tissue. 30. Cells of clover plant filled with the organism nucleus at *n*. 26. Rod and y shaped organisms from 30 more enlarged. 31. Single cell containing bacterioids. After Frank.

number of small cells. These spores serve, on account of their great resistance to dessication, and other unfavorable conditions, to tide the organism over until suitable conditions once more obtain. Bacteria are universally distributed, abounding in the soil, in the water, and being present often in the air, except at high altitudes. Normally, they are absent from the tissues of living animals and plants, but are to be looked for practically everywhere else. Their food requirements are as various as their habitats. Some require the most complex organic compounds, while others cannot live in the presence of such, but manufacture their own food from inorganic substances. Most bacteria lie between these two extremes. In respiration, some bacteria require oxygen or air, others will not develop in its presence. Most species require an abundance of moisture for their development, but many species will withstand a considerable amount of drying. Light inhibits the growth and in many cases destroys the bacteria. As to heat requirements, some live only in hot water, others will develop upon the surface of ice, some best at blood heat, while most develop between 15° and 22° C.

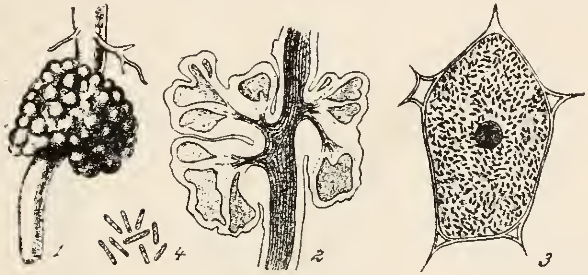

Fig. 22. Schizophyta. Schizomycetes. Nodule forming bacteria. *Rhizobium leguminosarum.* 1. Root tubercle of Lupine. 2. Cross-section of nodule. 3. Cell showing bacteria x 600. 4. Bacteria x 1500. After Woronin and Fischer.

Bacteria are also important in connection with the decomposition of organic matter. The nitrifying bacteria in the soil change the complex albuminous substances into nitric acid. This uniting with a base forms nitrates. The tubercle bacteria like *Rhizobium leguminosarum* are in mutual relation with clover and other leguminous plants and are important in the acquisition of nitrogen. Some bacteria play an important part in the dairy industry, the aroma and flavor of butter being due to these. Some, like the red milk organism (*Bacillus prodigiosus*), produce bad and disagreeable odors or cause the milk to become viscid or colored. Vinegar is produced by the acetic acid bacillus (*Bacillus aceticus*). Some bacteria produce diseases of plants like Fire blight of apples (*Bacillus amylovorus*), Cabbage rot (*Pseudomonas campestris*), Sorghum Blight, Corn wilt, etc. Some bacteria produce diseases of insects like Foul brood of bees, Silk worm disease, etc.

BACTERIA; POISONOUS PROPERTIES. It is believed best to consider in a general way, the various poisonous principles which are developed by bacteria before the discussion of the specific organisms and their specific poisons. Inasmuch as bacteria play a very important part in nature in breaking down dead tissues of all kinds, destroying them and returning them to their elements, or forming simple compounds, it is to be expected that among the multitude of chemical substances which are developed, there would be some which would be harmful when taken into the body of man or animal. In fact, such decomposition products are known and as most of them, probably all, are basic, containing nitrogen, they have been grouped with that general class of vegetable alkaloidal substances called *Ptomains*. If other poisonous substances than Ptomains are developed, they are not known at the present time. In addition to these poisonous substances that arise as decomposition, other poisonous substances are produced by certain bacteria which are strictly synthetic, that is not produced by the breaking down of complex compounds into more complex forms. The exact chemical nature of these substances is not understood, the reasons for this being that they are extremely unstable, it being impossible to heat them without destroying, and they cannot be recognized by any known chemical means. They must be distinguished and differentiated, and often detected only by animal inoculation and experimentation. These soluble substances excreted by the bacteria are called toxins. The term toxin is rather an unfortunate choice, because it refers simply to their poisonous properties. In the broad sense, any poisonous substance is a toxin, but in the sense in which it will be here used, toxin indicates specific bacterial poisons excreted into the medium in which the organism is growing, and producing upon inoculation, anti-toxins. In addition to the products above mentioned, many bacteria undoubtedly owe their poisonous or intoxicating qualities to the fact that the protoplasm of living matter of the organism is poisonous or contains poisonous substances which are not excreted into the surrounding medium. When bacteria of this type are allowed to grow in favorable culture media for a considerable length of time, there is a certain amount of self-digestion or autolysis which takes place and these

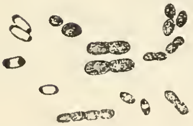

Fig. 23. *Bacillus cloaceae* from corn, cause of corn disease, also found in sewage. Supposed at one time to produce toxic substances to which was attributed the corn stalk disease. After Burrill.

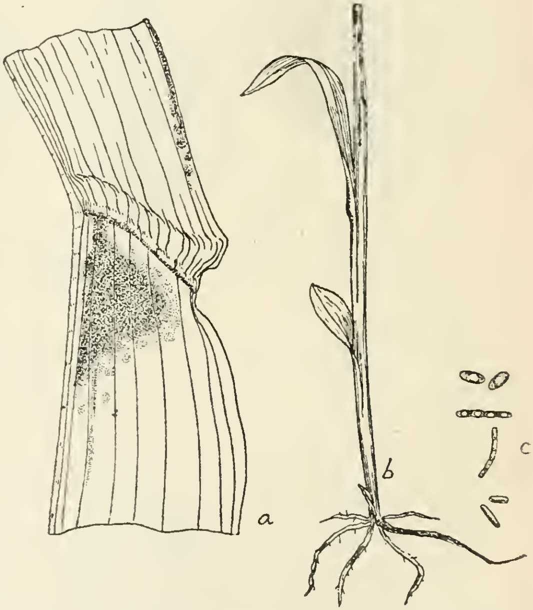

Fig. 24. Sorghum Blight (*Bacillus Sorghi*). *b* Young plant infected with the organism. *a* leaf and sheath. *c* Bacilli. Modified after Kellerman and Swingle.

poisonous contents of the cells are liberated and then go into solution. They may be liberated, also, by grinding the bacteria, and extracting with water. These poisonous protoplasmic substances have been called toxalbumins, but this term commits one to the supposition that all of this type of poisonous substances are proteid in nature. This has been by no means proven, consequently the term endotoxins is to be preferred.

The following terms used in discussions of immunity will need defining.

An Antitoxin is a substance capable of neutralizing a toxin by combining with it, and is produced in the animal body as a reaction to the introduction of a toxin in non lethal doses.

A Bacterial Agglutinin is a substance produced in the animal body as a reaction to the presence of certain bacteria or their products. When introduced into a suspension of the organism the agglutinin will cause the bacteria to clump (agglutinate) into groups.

A Bacteriolysin is a substance produced in the animal body as a reaction to the presence of bacteria or their products which will destroy and dissolve the corresponding (homologous) organisms.

An Opsonin is a substance found in the blood serum which will unite with bacteria and render them positively chemotactic for the white blood cells. This preliminary union of opsonin and bacterium seems to be necessary before engulfment and destruction of the bacteria by the white blood cells can take place.

In discussing the specific effects and products of the various species of bacteria, there would be an advantage in grouping these bacteria, according to the substances produced, and their effect upon animals and man. However, that this portion may be in keeping with the remainder of the text, the specific effect will be discussed and noted under each organism, and the organisms put in their correct place in the genera of Migula's system of classification. In many instances, bacteria not closely related produce effects that are very similar; in some of these cases, the discussion will be under the first of that group reached, the remainder of the group will contain simply the reference to the form under which the discussion is given.

COCCACEAE

Organisms globose or spherical in a free state, not elongated in any direction before division into one, two, or three planes, when united in pairs or groups, sometimes flattened on the proximal sides, containing five genera, three of which are of importance from our point of view.

BACTERIACEAE

Cells cylindrical or oval, dividing only in one plane, cells straight, rod-shaped, without sheath, either non-motile or motile, by means of flagella; contains three genera.

SPIRILLACEAE

Cells cylindrical, dividing in one plane, not straight, being bent or spiral, and without sheath; contains four genera.

CHLAMYDOBACTERIACEAE

Cells cylindrical, dividing in only one plane, enclosed in a sheath; contains five genera.

BEGGIATOACEAE

Cells cylindrical, dividing in only one plane, destitute of the sheath, united into threads containing sulphur granules, usually motile by means of the undulating membrane. One genus only.

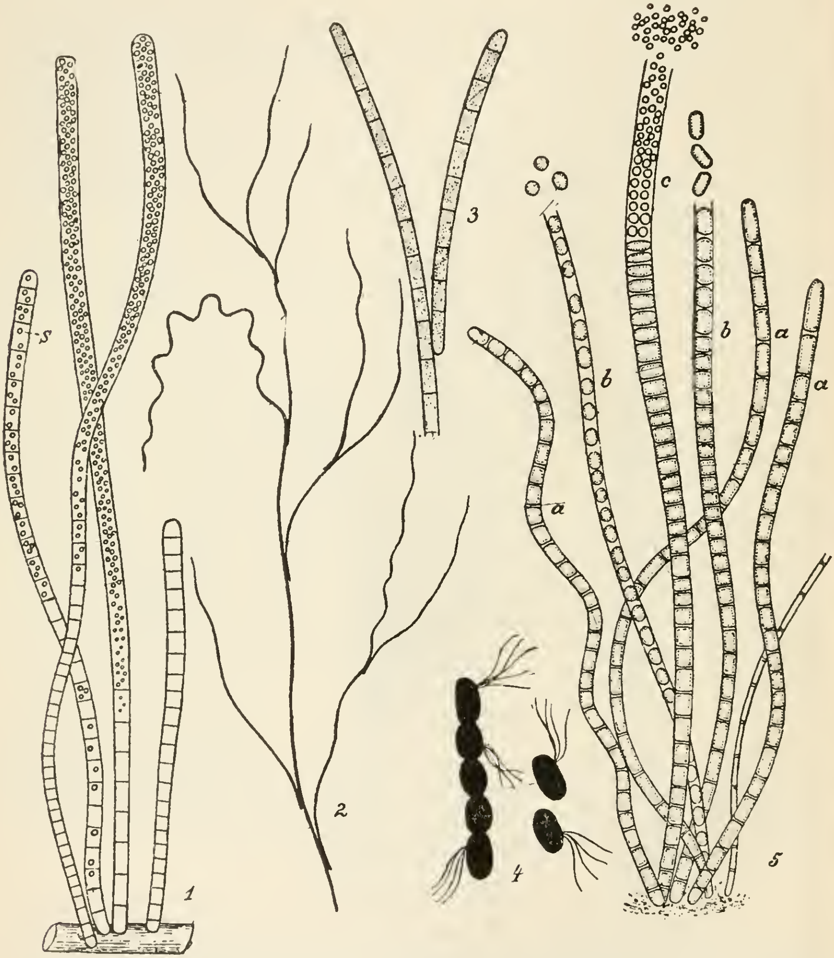

Fig. 25. Chlamydobacteriaceae and Beggiatoaceae. 1. *Beggiatoa alba*, s Sulfur granules x 800. 2-4. *Cladothrix dichotoma*; 2 Caenobium x 350. 3. Part of filament magnified 1000 times. 4. Cells with flagellae x 1000. 5. *Crenothrix polyspora*; a, young threads; b, threads separating into bodies; c, older threads with spores x 1000. Fig. 1, 2, and 5, after Zopf, Fig. 3 and 4 after Migula.

MYXOBACTERIACEAE

In the vegetative stage these occur as swarming rod-shaped organisms held together by a gelatinous substance secreted by the cells; they show slow creeping movements. They form cysts in which the spores occur. This very peculiar

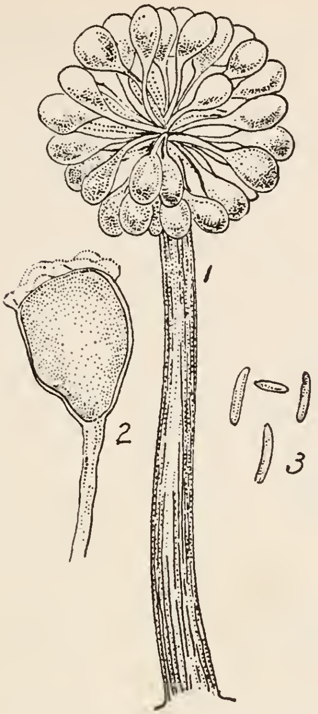

Fig. 26. Myxobacteriaceae. *Chondromyces pedunculata.* 1. General form of fructification, cyst and pedicel. 2. Single cyst. 3. Rods forming the mass in cyst. After Thaxter.

group first described by Thaxter lives on the dung of animals and in habit resembles the Slime Moulds or Myxomycetes.

COCCACEAE

Micrococcus pyogenes, Var. *albus*, Rosenbach

White-pus Coccus.

This organism, when grown upon artificial media, produces no pigment, otherwise it is identical with the following.

Micrococcus pyogenes, Var. *aureus*, Rosenbach

Golden-pus Coccus.

Infections produced. This organism, or the preceding; or both, are found very generally associated with, and usually as the cause of wound infection and suppuration in general. They are usually found in furuncles, abscesses, carbuncles, and other inflammatory processes affecting the surface of the body. When present under certain conditions in the blood or various internal organs, they cause pyemia, septicemia, ostemyelitis, inflammations of serous membranes such as pleuritis, peritonitis, ulcerative endocarditis, etc.

Pathogenesis. Infection with this micrococcus causes a marked hyperleucocytosis. Its presence in tissues is generally followed by the production of pus made up of serum, polymorphonuclear leucocytes, disintegrated tissue, and the bacteria. Ordinarily, the area of infection and inflammation is walled off by an infiltration of the surrounding tissues by these polymorphonuclear leucocytes, forming the so-called pyogenic membrane.

Poisonous properties. In 1894, Van der Velde discovered that sterile filtrates from cultures of Micrococcus contain an hemolysin, which he termed staphylotoxin. In 1901, Neisser & Wechsberg studied this hemolytic substance and gave to it the name staphylolysin. This substance will cause the erythrocytes to dissolve whether within or without the body. A true toxin, leucocidin, is produced under certain conditions. It causes the leucocytes to swell up and their nuclei to disappear. Leucocidin and staphylolysin differ from the true toxins in that they are not capable of producing anti-toxins after having been heated, i. e., toxoids are not formed. The normal blood serum, however, of man and animals contains more or less of this anti-toxin. The presence of an endotoxin has not been demonstrated.

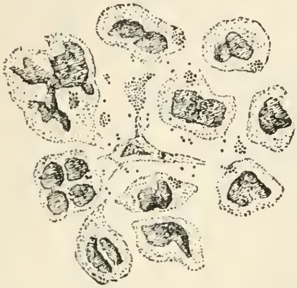

Fig. 27. Pus organism (*Staphylococcus pyogenes aureus*) shown in irregular bunches. After Flügge.

Immunity. The resistance of the body may be heightened by immunization with pure cultures of the organism. Immunity is undoubtedly due in large part to the phagocytic activity of the leucocytes. It seemed that virulence of the organism has very little relation to the production of toxins by them for some very virulent types produce very small quantities of toxin. There is some substance secreted which is positively chemotactic to the phagocytes. Immunization is not due to the production of bacteriolysins in the blood. Immune sera have been produced, but have not proven to be of any practical importance. Vaccination is held by Wright to raise the opsonic index of the blood; to this he attributes increased resistance. Agglutinins are present in normal sera in most cases, but systematic injection greatly increases the agglutinating power of the blood.

Micrococcus caprinus, Mohler and Washburn

Disease produced. Takosis.

Animals originally infected. Angora goats.

Susceptible animals. Mouse, guinea pig, rabbit.

Animals naturally immune. White and brown rat, chicken, dog, and sheep.

Pathogenesis. Anatomically characterized by emaciation and anemia, congested pneumonic areas in the lung, splenitic atrophy, and induration, spleen often being attached to the diaphragm and neighboring organs by fibrous tissues. The mucous membranes exhibit necrosed areas of mucosa and bacteria are distributed through the blood, consequently may be isolated from any of the internal organs.

Poisonous properties. Microscopically, the lungs are found with many of the terminal bronchioles and alveolae filled mucus and desquamated epithelium, in the liver, hyperaemia with fatty degeneration of periphery of many of the acini, catarrhal nephritis, localized areas of parenchymatous degeneration in the heart; capsule of the spleen thickened and contracted. Small intestines with a local superficial or completed necrosis of the glandular areas. The blood examination shows polycythemia, leucocytosis, and in advanced stages, general poikilocytosis. True toxins not produced.

Immunity. Filtrates seem to have some immunizing power, probably either bactericidal or opsonic. The serum of immune animals has little or no immunizing power. Sterilized cultures and filtrates heated for thirty minutes at 60° C. lose their immunizing power.

Miccrococcus meningitidis, (*Diplococcus intracellulus meningitidis*, Weichselbaum)

Name of disease. Epidemic cerebro-spinal meningitis.

Animals infected naturally. Man.

Animals susceptible. None, except when injected into a cavity in large quantities. Subdural inoculations in most cases produce a meningitis which, however, does not agree with that produced in man.

Pathogenesis. Severe inflammation of the meninges of both brain and spinal column characterized by the production of considerable quantities of pus. The lumbar puncture and a microscopic examination of the pus will show the organisms present in large numbers. Probably the organisms sometimes reach the blood stream, and secondary infections are produced in various parts of the body by metastisis. It is very probable that the organism is present in acute rhinitis, and that the infection of the brain and spinal cord is secondary.

Poisonous properties. Lipierre extracted what he called a toxin with glycerine, from old culture.

Immunity. Second attacks of the disease are very rare. Lipierre claims to have immunized animals with the toxin and with cultures produced a preventive curative serum from immunized animals. Davis states that there is developed a bactericidal property in the serum, and also agglutinins.

Micrococcus lanceolatus, Fraenkel

Disease produced. Acute infectious pneumonia.

Animals infected naturally. Man (and domestic animals).

Animals susceptible. Rabbit, guinea-pig, dog, and mouse.

Animals immune. Chicken and pigeon.

Pathogenesis. The lungs are most frequently the seat of infection. The infected portion passing through several stages; first, that of congestion, in which the air cells become filled with blood serum and red corpuscles, the former coagulates, the tissues become liver-like in consistency; this is followed by a marked invasion of leucocytes; the contents of the air cells soften and are absorbed and discharged. In most cases of the disease, blood infection probably occurs, consequently, in many cases, infection of various other organs. Pleuritis is most common, then pericarditis, and even generalized peritonitis. endocarditis, arthritis, meningitis, otitis media, conjunctivitis, osteomyelitis, and degenerations in various internal organs, particularly the kidneys and liver.

Poisonous properties. Poisonous substances are produced in greater or smaller quantities in culture media, but no true soluble toxin. Presumably, there is present an endotoxin. The pneumotoxin seems to be toxic toward all the organs of the body.

Immunity. Immunity is probably due largely to phagocytosis, and it is likewise probable therefore, that it is due in large part to the opsonin content of the blood. There are no bactericidal or anti-toxic substances formed in immune blood. The blood serum of an immunized individual exhibits an increased agglutinating power. Immune sera for the prevention of the disease have not proven a success.

Micrococcus tetragenus, Gaffky

Disease produced. Associated with the tubercle-bacillus, and probably of importance in complicating the pus infections.

Animals infected. Man and animals.

Animals susceptible. White mouse, and guinea-pig.

Animals immune. House-mouse, field mouse, dog, and rabbit.

Pathogenesis. Inoculation of white mouse causes fatal bacteremia. The organism is found in tubercular infections, and probably hastens the necrosis of infected tissue. In some cases it may be the primary infecting agent.

Poisonous properties. Not known.

Immunity. Not known.

Micrococcus catarrhallis, Seifert

Disease produced. Superficial inflammations of the respiratory tract and conjunctiva.

Animals infected. Man.

Animals susceptible. None of the laboratory animals are susceptible, except when the organism is introduced in very large quantities.

Pathogenesis. Probably the primary cause in some cases of conjunctivitis, bronchitis, and catarrh, and in general superficial inflammations of the respiratory passages.

Poisonous properties. Not known.

Immunity. Not known.

Micrococcus gonorrheae, (Diplococcus of Neisser)

Disease produced. Gonorrhea.

Animals infected. Man.

Animals susceptible. None of the laboratory animals are susceptible.

Pathogenesis. Producing a severe inflammation of the mucous membranes of the urethra accompanied by blennorrhea. Secondary infection of fallopian tubes, ovaries, urethra, etc., may occur.

Poisonous properties. Not known.

Immunity. Probably some immunity is developed after infection, but is not lasting. No method of immunizing is known.

Streptococcus equi, Schütz

Disease produced. Strangles.

Animals susceptible. Horses, asses, and their hybrids, and mouse.

Pathogenesis. Producing a severe catarrh of the nasal mucosa, with a swelling of the sub-maxillary, and pharyngial lymphatic glands, abscesses generally form in the latter. May terminate in pharyngitis in a purulent pneumonia or pleuritis. Sometimes cutaneous exanthemata. Metastatic abscesses may appear in various lymph glands.

Poisonous properties. Not fully studied, but probably the same as those of the next organism, Streptococcus pyogenes.

Immunity. Not known.

Streptococcus pyogenes, Rosenbach. (*Streptococcus erysipelatos*, Fehleisen)

Disease produced. This organism in various forms of inflammation and septic inflammation in general, sometimes alone, sometimes associated with Micrococcus pyogenes albus, and aureus. Its specific cause, in many instances of septicemia, pyemia, phlegmon, abscesses, boils, erysipelas, ulcerative endocarditis, periostitis, otitis, meningitis, pneumonia, lymphangitis, bronchitis, inflammation of the serous membranes, as pericarditis, pleuritis, peritonitis arthitis, enteritis, endometritis, tonsillitis, salpingitis, has been held by some authors to cause rheumatic fevers and also scarlet fever. Probably many so-called terminal infections are produced by this organism.

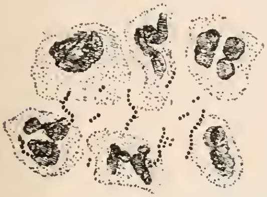

Fig. 28. Pus organism. *Streptococcus pyogenes.* In chains, with pus cells x 800. After Flügge.

Pathogenesis. The organism is one of the pyogenic forms reacting much as the Micrococcus pyogenes, as has been described.

Poisonous properties. In many strains of Streptococcus pyogenes, there is present an endotoxin. This is little understood, however, at the present time. It is found that this endotoxin varies greatly; in some cases none at all being found in virulent types. It is susceptible to heat; organisms killed by chloroform being more poisonous than those killed by heat. Virulent streptococci also produce an hemolytic toxin called streptocolysin. This is a true toxin. The blood in fatal cases of streptococcic septicemia is often laked. The toxin is destroyed at a temperature of 70° for two hours and by peptic digestion. Substances which kill the leucocytes are also present in certain strains and inhibit phagocytosis. It is very probable that the pathogenic character of this organism is not entirely explained by its known toxic properties.

Immunity. Immunity against infection of streptococcus is probably due largely to the presence of opsonins in the blood, and the consequent activity of the phagocytes. Sera of animals which have been immunized by inoculation of non-virulent or killed cultures seems to have some protective effect. Such has not come into general use, however. Agglutinins are produced for most strains.

BACTERIACEAE

Bacillus suipestifer, Salmon & Smith

Disease produced. Hog cholera. Probably not the primary cause, but associated with some unknown ultra-microscopic organism.

Animals infected. Swine.

Animals susceptible. Rabbits.

Pathogenesis. Post mortem examination reveals numerous petechiae, ecchymoses, and extravasations of blood into various tissues. This latter is particularly evident beneath the serous membranes. The spleen is enlarged, soft, and engorged. In subacute cases, large intestinal ulcers are formed.

Poisonous properties. Novy gave the name susotoxin to a poison base which he discovered in pure cultures. This is probably not a specific poison of the organism, certainly not a toxic.

Immunity. Vaccination with killed or attenuated cultures develops an immunity, while vaccination against this particular organism is successful, it is not of practical importance, because of the fact that this particular organism is not the primary cause of the disease. Agglutination is well marked, and has been used in diagnosis.

Bacillus piscidus agilis, Sieber

Disease produced. No specific name given.

Animals infected. Fish.

Animals susceptible. Frogs, mice, rabbits, dogs, and guinea-pigs upon inoculation.

Pathogenesis. Disease is marked by shortness of breath, unrest, apathy, and finally paralysis.

Poisonous properties. The filtrate of cultures is poisonous, also the distillate. Cadaverin, and other known ptomains have been obtained from cultures.

Immunity.

Bacillus coli, (*Bacterium coli commune*, Escherich)

Disease produced. This organism is a normal inhabitant of the intestinal tract of man and animals but under certain conditions produces inflammation of the internal organs, such as choleocystitis, peritonitis, meningitis, cystitis, suppurative nephritis, and even generalized septicemia.

Pathogenesis. This organism is not highly pathogenic under ordinary conditions, and when found in inflammatory processes, it is generally associated with other organisms. Undoubtedly, one of the reasons why this organism is found in various organs in post mortems, is the fact that it gains entrance into the blood just before death, producing the so-called agonal invasion.

Poisonous properties. No specific coli-toxin has been produced.

Immunity. Animals may be immunized by the injection of killed cultures. The immunization resulting from the formation of bactericidal amboceptors and agglutinins.

Bacillus enteritidis, Gaertner

Disease produced. Meat poisoning.

Animals infected. Man.

Animals susceptible. Mouse, guinea pig, rabbit, pigeon, lamb, and goat.

Animals immune. Dog, cat, rat, pigeon, and sparrow.

Pathogenesis. It is believed at the present time, that many of the so-called cases of ptomaine poisoning which have occurred in the past, and been recorded as such in medical literature, are due to the presence of this organism, and its soluble toxin. The organism has been isolated repeatedly from spleen of fatal cases. The disease is contracted by eating infected meat, and is characterized by vomiting, and violent diarrhoea, followed by collapse, head-ache, and not infrequently urticarial or herpetic eruptions. Anatomical findings are not specific. Meat undoubtedly is infected only when coming from animals sick with an intestinal or general infection before they were slaughtered.

Poisonous properties. The organism produces in the meat, a soluble heat-resistant toxin in considerable quantities. This toxin in its heat-resisting properties, differs from most toxins and also in the fact that no anti-toxins are produced. Sufficient toxin is usually present to give the first effects of the disease. The organism itself may or may not gain entrance into the circulation or organs.

Immunity. As before stated, anti-toxins are not developed. Agglutinins, however, are developed.

Bacillus typhosus, Zopf

Disease produced. Typhoid fever.

Animals infected. Man. Inoculation of experimental animals usually negative, except when injected in considerable quantities.

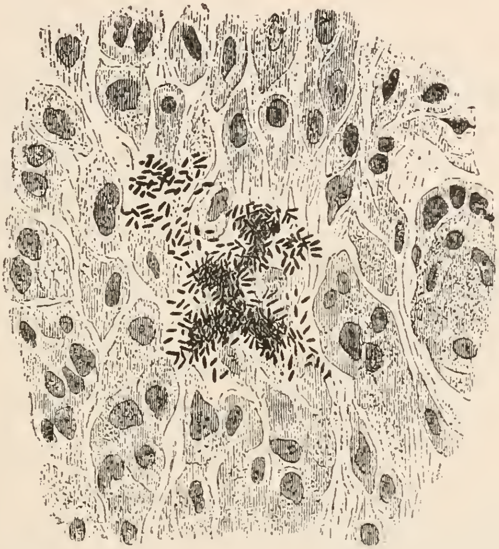

Fig. 29. Typhoid fever bacillus. (*Bacillus typhosus*). Section from spleen showing bacteria clustered in center. After Flügge.

Pathogenesis. The organism invades the solitary lymph nodes and Peyer's patches in the intestine and produces more or less necrosis and sloughing of tissue. By means of the lymphatic channels, the internal organs are all infected, particularly the spleen which becomes very much enlarged. The bacilli invade the blood, and hence the disease is a true bacteremia. When they lodge in bony tissues, osteitis, periosteitis, and osteomyelitis may be produced.

Poisonous properties. No soluble toxin has been discovered, an endotoxin, however, is present and may be secured through self digestion in cultures, or by grinding and extracting the bodies of the bacteria.

Immunity. No true anti-toxin serum has been produced, inasmuch as no toxin has been discovered. The blood serum of typhoid patients agglutinates the bacteria. Vaccination with killed cultures produces an immunity which lasts probably in most cases several years. The blood serum of animals immunizes against typhoid bacilli, but is not used because it is quickly thrown out of the system when injected, and because it possesses very little curative quality.

Bacillus tetani, Flügge

Disease produced. Tetanus, or lock-jaw.

Animals infected. Man, white mouse, rabbit, guinea pig, mouse, rat, horse, to a less degree cattle and most other warm blooded mammals. Most birds, amphibians, and reptiles are immune.

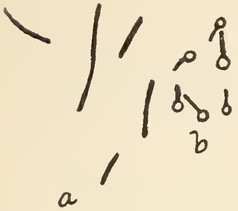

Fig. 30. Tetanus Bacillus. *Bacillus tetani.* Spores and rods. *a.* Vegetative stage. *b.* Spore stage. After Abbott.

Pathogenesis. There are no gross characteristic anatomic changes, but microscopic degenerative lesions may be found in the ganglionic cells. The disease is characterized usually by a tetanus or rigidity of muscles.

Poisonous properties. A tetanus toxin is produced in quantities in media. It is believed to contain two principles; the first of which, the more important, affects the nerves, and is called tetanospasmin; the second which is hemolytic in its action is called tetanolysin. The toxin is destroyed by gastric and pancreatic digestion. It has a strong affinity for nervous tissue; in test tube, practically all of the toxin will become fixed. It is absorbed in the body by the motor ends of the nerves and passes through this by means of the axis cylinders to the ganglionic cells.

Immunity. Natural immunity is probably in part at least, phagocytic in nature, but the presence of a toxin in the blood or in the body causes the production of the anti-toxin. The serum of animals immunized by toxin injections, contains quantities of this anti-toxin, so that it is used in immunization against, and in the cure of tetanus.

Bacillus botulinus, Von Ermengen

Diseases produced. Botulism, or meat poisoning.

Animals infected. Man, principally.

Animals susceptible. Guinea pig.

Animals immune. Dog and rat.

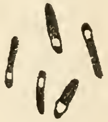

Fig. 30a. An organism found in sausage. *Bacillus botulinus.* After Jordan.

Pathogenesis. The ingestion of meat containing bacillus botulinus is followed, in from a day to a day and a half, by salivation, ptosis, bulbar paralysis, and death in from 25 to 50 per cent of the cases. It produces degeneration of glandular organs anid vascular endothelium and consequent hemorrhages.

Poisonous properties. The organism growing in meat produces a characteristic toxin and it is this toxin already formed which produces disease, and not the proliferation of the organism after gaining entrance to the body. It has been found in decomposed hams, and sausages. The toxin differs from that of diphtheria and tetanus in that it is not digested by the gastric juice. It has a special affinity for nervous tissues, but is not so selective as tetanus toxin.

Immunity. Immunization with the toxin results in the formation of an anti-toxic serum which may be used in immunizing against the disease, or in curing. However, this disease is so rare that it is of no commercial importance in this country.

Bacillus alvei, Chesire & Cheyne

Disease produced. European foul brood.

Animals infected. Honey bees.

Animals immune. None of the higher animals contract the disease when the organism is inoculated.

Pathogenesis. Destroys the larva of the honey bee.

Immunity. Not known.

Bacillus larvae, White

Disease produced. American foul brood.

Animal infected. Honey bee.

Animals immune. All higher animals.

Pathogenesis. Destroys the larva of the honey bee.

Poisonous properties. Not known.

Immunity. Not known.

Bacillus anthracis-symptomatici, Kruse

Disease produced. Black leg, Quarter evil or symptomatic anthrax.

Animals commonly infected. Cattle.

Animals susceptible. Guinea pig, hog, dog, and rabbit.

Animals immune. Bird, horse, goat.

Pathogenesis. Irregular emphysematous pustules and areas. Muscles contain dark areas with blood serum and gas bubbles.

Poisonous properties. Doubtful, probably an endo-toxin.

Immunity. Established by vaccination with the Bacillus attenuated by exposure to heat and drying.

Bacillus oedematis, Zopf

Disease produced. Malignant oedema.

Animals infected. Horse, sheep, goat, mouse, guinea pig, rabbit, dog, pig, chicken, and pigeon.

Animals immune. Cattle.

Pathogenesis. There is little blood infection by the organism, but a general emphysema of the sub-cutaneous tissues, the gas bubbles being usually very numerous. Any of the body tissues may be affected.

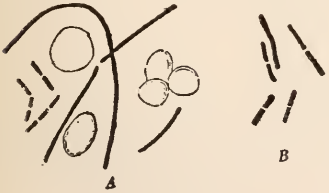

Fig. 30b. Malignant Oedema. *Bacillus oedematis maligni.* A. From spleen of guinea pig. B. From lung of mouse. Both x 700. After Koch.

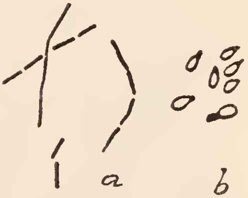

Fig. 30c. Malignant Oedema. *Bacillus oedemati maligni.* Spores and rods. After Abbott.

Poisonous properties. Not definitely known.

Immunity. Immunization may be affected by vaccination with attenuated cultures. Attenuation is arrived at by passage of the organism through white rats.

Bacillus murisepticus, Koch

Disease produced. Mouse septicemia.

Animals susceptible. Hog, rabbit, mouse, white rat, pigeon, and sparrow.

Animals immune. Horse, cow, ass, guinea pig, cat, chicken, and goose.

Pathogenesis. The organism has been isolated from poisonous meat. Inoculations produce a true bacteremia. Microscopic examination shows the organism to be present principally in the capillaries. The spleen is enlarged, but otherwise, the internal organs show no characteristic lesions.

Poisonous properties. Unknown.

Immunity. Vaccination with killed or attenuated cultures, immunizes, but the serum of immunized animals possesses little curative power.

Bacillus psitticosis, Nocard

Disease produced. Epidemic pneumonia contracted from diseased parrots.

Animals infected naturally. Parrots and man.

Animals susceptible. White and gray mouse, pigeon, rabbit, and guinea pig.

Animals immune. The dog is partially immune.

Pathogenesis. The disease is a true bacteremia, being associated in man with pneumonia.

Poisonous properties. Not known.

Immunity.

Bacterium influenzae, Lehman & Neumann

Disease produced. Influenza in man.

Animals susceptible. Rabbit, and guinea pig.

Animals immune. Most of the other laboratory animals.

Pathogenesis. Produces purulent bronchitis, and pneumonia. Sometimes there is metastatic infection of other organs producing diseases such as endocarditis.

Poisonous properties. The toxin is intracellular, probably an endotoxin.

Immunity. Vaccination and inoculation do not confer a lasting immunity, in fact, infection in many cases tends to predispose to the disease.

Bacterium cancrosi, Kruse

Disease produced. Chancroid, or soft chancre.

Animals infected. Man.

Animals susceptible. Some of the monkeys.

Animals immune. Other laboratory animals.

Pathogenesis. Disease produced appears first as a small red, papule which becomes larger, and ulcerates. The inguinal and other lymph nodes enlarge and ulcerate. Primary infection most frequently upon the genitalia, other tissues not frequently involved.

Poisonous properties. Not known.

Immunity. Acquired.

Bacterium pneumoniae, Zopf

Disease produced. Pneumonia.

Animals infected. Man.

Animals susceptible. Guinea pig, and rabbit.

Pathogenesis. The organism, probably an avirulent type, is found in normal saliva. Under some conditions, either alone or with other organisms, produces pneumonia or metastatic endocarditis, otitis media, and tonsillitis.

Poisonous properties.

Immunity. Not permanent, probably opsonic in nature.

Bacterium cholerae, Kitt

Disease produced. Chicken cholera, and rabbit septicemia.

Animals infected. Chicken, pigeon, goose, duck, rabbit, and mouse.

Pathogenesis. Generalized septicemia with minute hemorrhages, peritonitis, or the formation of diptheritic areas.

Poisonous properties. Not known.

Immunity. Agglutinins well developed and immunization with killed or attenuated cultures induces the formation of bacterolysins and probably opsonins. In cultural and pathogenic character, this organism is closely related to the four following, all being classed under the general group of organisms producing diseases known as pasteurellosis.

Bacterium suicida, Migula

Animals infected. Hog.

Animals susceptible. Rabbit, guinea pig, and less so chicken and pigeon. See preceding.

Bacterium sanguinarium, Moore

Disease produced. Infectious leukemia.

Animals infected. Chicken. See preceding.

Bacterium bovisepticum, Kruse

Disease produced. Hemorrhagic septicemia.

Animals infected. Cattle. See preceding.

Bacterium avium, Moore

Disease produced. Roup.

Animals infected. Chicken.

Bacterium astheneae, Dawson

Disease produced. Asthenia or going light.

Animals infected. Chicken.

Animals susceptible. Guinea pigs, and rabbits.

Pathogenesis. ?

Poisonous properties. Not known.

Immunity ?

Bacterium anthracis, Migula

Disease produced. Anthrax or splenic fever.

Animals infected. Mouse, guinea pig, rabbit, sheep, cattle, man.

Animals immune. Carnivora.

Pathogenesis. Oedema at point of inoculation, spleen very much enlarged, pulpy, internal organs generally hyperaemic. The organism is to be found in the blood in all parts of the body. Acute degenerative in parenchymatous organs.

Poisonous properties. Neither a soluble toxin nor an endotoxin has been demonstrated, though there is abundant evidence in the tissues of intense intoxication.

Immunity. Immunity may be developed by the inoculation with cultures of the organism grown at high temperatures. The blood serum of animals thus immunized possesses some immunizing power. Opsonins are probably important.

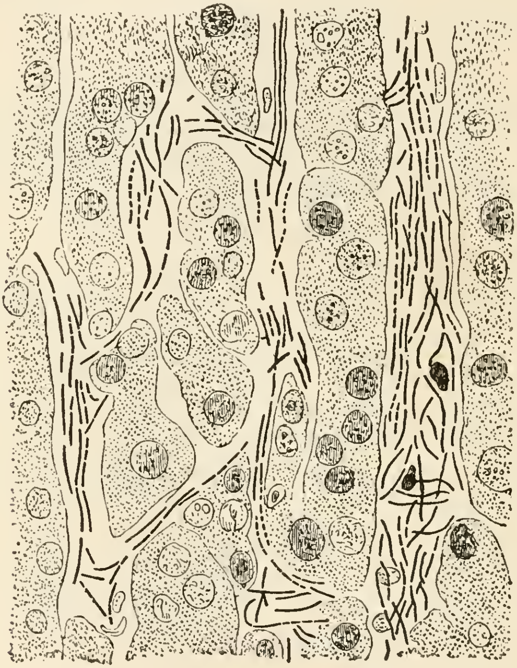

Fig. 30d. A section of liver showing anthrax bacillus (*Bacillus anthracis*) in blood vessels x 700. After Flügge.

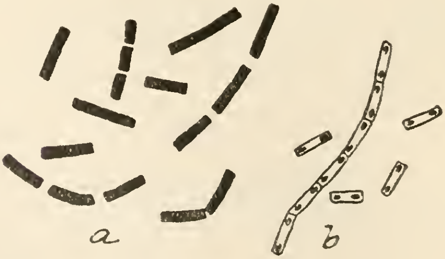

Fig. 30e. Same. *a*. From culture medium. *b*. Later stages forming spores.

Bacterium necrophorus, Flügge

Disease produced. Necrosis in various organs.

Animals infected. Calves, lambs, cattle, sheep, goats, antelope, reindeer, red deer, roe, horses, asses, hogs, kangaroos, rabbits, dogs, chickens, kite, guinea pigs, and on experiment mice and pigeons.

Pathogenesis. The local lesion is sharply marked off, usually yellowish, or of a dull brown, of a yeasty consistency, and having a characteristic odor of old cheese and glue. Often produces a diptheritic false membrane. It has been described as producing the following in various animals. Necrotic dermatitis, sheep-pox, abcesses in rabbits, necrobacillosis of the hoof, necrosis in digestive tract, stomatitis, vaginitis, metritis, foot-rot of cattle and sheep, necrotic omphalophlebitis in young animals, jointill, multiple necrosis in the liver, lungs, and avian diptheria, etc.

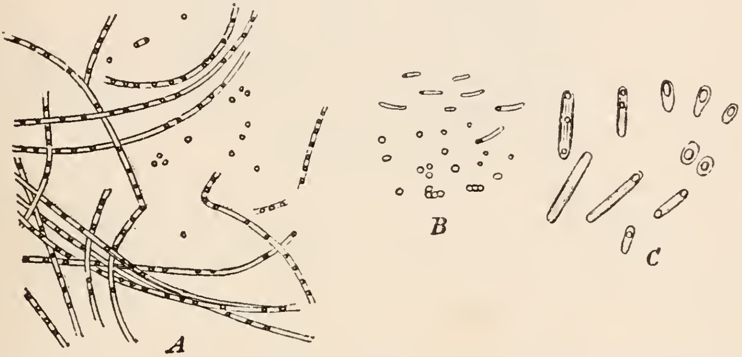

Fig. 30f. Bacillus of Splenic Fever. *Bacillus anthracis*. Spore formation and spore germination. A. From the spleen of a mouse after 24 hours culture in nutrient solution. B. Germination of spores x 650. C. The same x 1650. After Koch.

Disease produced. Diphtheria.

Poisonous properties.

Immunity.

Bacterium diphtheriae, (Flügge)

Animals infected. Man.

Animals susceptible. Horse, guinea pig, rabbit, mouse.

Pathogenesis. Local and general phenomena caused by a soluble toxin, and necrosis of mucous surfaces, and the underlying tissues, and false membrane often forms consisting of fibrin, leucocytes, etc. There is a mild leucocytosis, probably due in most cases to the co-ordinate activity of streptococci.

Poisonous properties. A true toxin is produced in the body and when grown in artificial media. It is this toxin which causes the characteristic clinical picture in diptheria.

Immunity. Injection of non-fatal doses of diptheria toxin results in the production of an abundance of anti-toxin in the blood. This blood serum has powerful curative and prophylactic properties, and has obtained wide usage in general practice.

Bacterium tuberculosis, (Koch)

Disease produced. Tuberculosis, consumption.

Animals infected. Probably no animal is immune to all of the varieties of this organism.

Pathogenesis. The disease generally runs a chronic course, affecting practically all of the organs in the body. In man, characteristic lesions are to be found in the lungs, in cattle generally on the peritoneum. The disease is characterized by the formation of numbers of nodules in the tissues, verying in size from a pin-point to that of an egg. At first, these are hard, and firm throughout, but as they grow larger, generally casease. Microscopically, these tubercules are characterized by the presence in the center of the so-called giant cells with numerous nuclei surrounded by concentric rings of epithelioid and lymphoid cells.

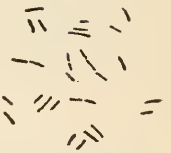

Fig. 30g. Tubercle organisms. *Bacterium tuberculosis.* After Mohler and Washburn.

Poisonous properties. Not definitely or thoroughly understood, but probably an endotoxin. The killed bodies of the bacteria or the product of their growth in media when injected into animals affected by tuberculosis, cause a characteristic temperature reaction. The material thus injected into animals for diagnostic purposes, is called tuberculin, and is in general used in veterinary practice.

Immunity. Agglutinins are produced in infected animals. Recovery from the disease occurs in many cases doubtless from the walling in of the bacteria. Artificial immunity may be experimentally produced by increasing the opsonic content of the blood, but as yet no accepted method of immunization has been developed.

Bacterium mallei, (Löffler) Migula

Disease produced. Glanders, and farcy glanders.

Animals infected. Usually the horse and ass.

Animals susceptible. Man, goat, cat, hog, field mouse, wood mouse, rabbit, guinea pig, hedge hog.

Animals immune. Cow, house mouse, white mouse, and rat.

Pathogenesis. The lesions usually appear in the horse and ass in the form of discrete, sharply marked ulcers upon the mucous membrance of the nose. The ulcers once formed generally remain open and continue to discharge pus. The lymphatic glands are infected, and generally the submaxillary glands enlarge and ulcerate. Infection of the lungs often occurs through inhalation. Another type of the disease is characterized by infection of the sub-cutaneous lymph channels, which become enlarged and ulcerate, breaking through the skin at various points.

Poisonous properties. This organism produces some poisonous principle similar in a sense to that found in tuberculin and under the name of mallein is used in the diagnosis.

Immunity. Successful immunization of animals against glanders has not been accomplished.

Bacterium leprae, (Hansen) Lehmann Neumann

Disease produced. Leprosy.

Animals infected. Man.

Animals immune. Laboratory animals.

Pathogenesis. The organism is found present in leprous tissues, almost filling the cells in many instances. Several types of leprosy are differentiated on the basis of the organ or tissues in the body infected. In many of its aspects, the disease resembles tuberculosis.

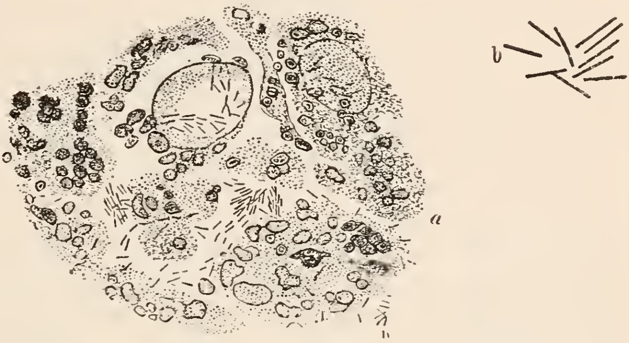

Fig. 30h. Glanders bacillus. *a.* Section through "glandereal" tissue, the small rods massed or single. *b.* Bacilli stained with methyl-blue. After Flügge.

Poisonous properties. The organism has not been successfully cultivated. Poisons are unknown.

Immunity.

Bacterium pestis, Lehmann-Neumann

Disease produced. Bubonic plague.

Animals infected. Man.

Animals susceptible. Rat, guinea pig, monkey.

Pathogenesis. Infection usually cutaneous. The lymph glands become swollen, and hemorrhagic and undergo more or less extensive necrosis, generalized septicemia in many cases, pneumonia and hemorrhages in various mucous membranes, especially in the stomach and endothelial surfaces, such as the pericardium and in various parenchymatous organs, with extreme degeneration of the latter. Spleen swollen.

Poisonous properties. The toxic substance is obscure. The filtrates from young cultures usually show little, or no toxicity; the older, more. The toxic substance seems to be susceptible to heat and is present in cultures killed by chloroform.

Immunity. Immunity may be conferred by the injection of sterilized or attenuated cultures, and this vaccination is practiced in some Asiatic countries.

Microspira comma, Schroeter

Disease produced. Asiatic cholera.

Animals infected. Man.

Animals susceptible. Laboratory animals naturally are immune to the disease, but by preventing peristalsis, and neutralizing the acid gastric juice, some experimenters have succeeded in producing the disease. The guinea pig is susceptible to intraperitoneal inoculation.

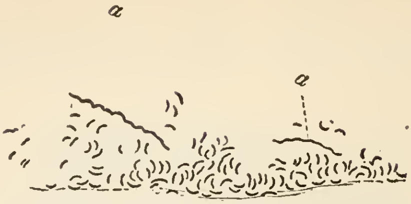

Fig. 30i. Cholera organism. *Microspira comma.* From the margin of a drop of broth containing pure culture of the Spirillum. *a.* Long spiral filaments. All x 600. After Flügge.

Pathogenesis. It is essentially an intestinal disease, the organism living within the intestines. The characteristic lesions are produced through the absorption of the poisonous matters there produced. Large and small intestines deeply congested, diarrhoea, Peyer's patches and glands swollen, eventually mucosal necrosis in part. Ulcers eventually form, though perforations are rare. The parenchymatous organs show marked signs of degeneration; the vascular system, the nervous and respiratory systems show no characteristic lesions.

Poisonous properties. The essential poison is intracellular, undoubtedly an endotoxin. It is found in the filtrate of old cultures and in solution of bacterial cells.

Immunity. Produced by considerable quantities of bacteriolysins and probably opsonins. Agglutinins are also produced. Vaccination with killed or attenuated cultures has proven fairly successful, but not the use of the blood serum of immunized individuals as a curative or a prophylactic agent.

SPIRILLACEAE

Spirochaeta pallida

Disease produced. Syphilis.

Animals infected. Man and ape.

Animals immune. Other animals.

Pathogenesis. Produces primary lesions in form of ulcers at the point of inoculation, second as gummata in the parenchymatous organs.

Poisonous properties. Not known.

Immunity. Not well understood.

Spirochaeta anserina, Sakharoff

Disease produced. Goose septicemia.

Animals infected. Goose.

Animals susceptible.

Pathogenesis. Producing septicemia.

Immunity.

Spirochaeta Obermeieri, Cohn

Disease produced. Relapsing fever.

Animals infected. Man.

Animals immune. Mouse, rabbit, sheep, and hog.

Pathogenesis. Produces relapsing fever in man.

Immunity.

CHLAMYDOBACTERIACEAE

Cladothrix bovis (Bollinger)

The mass consists of several distinct zones of different elements, the central portion granular with small round bodies radiating out from this tangled mass of thread-like bodies, the outer portion consisting of conspicuous club-shaped colonies. The organism is quite polymorphic. In cultures the threads are from 3 10 to 5-10 μ in thickness with flask-shaped or bottle-like expansions. The organism may be grown upon all the artificial media. The colonies appear as small gray dots with translucent, radiating filaments. If kept for a few days at 37° C. they are opaque and nodular, later they show a whitish downy appearance. In blood serum the nodules are yellowish or blood-red in color; on agar agar the color becomes brownish with age; on potato, reddish-yellow and the white down makes its appearance early.

Distribution. Widely distributed both in Europe and North America.

Pathogenic properties. The organism was discovered by Langenbeck in 1845, but was not described until 1878 by Bollinger. Israel in 1874-78 called attention to the disease in man, and Boström in 1899 made a careful study of the disease. The disease is not common in man but cases have been described by Murphy and Ochsner and Senn of Chicago. Two of the cases described by Murphy began with tooth-ache and swelling of the jaw.

The disease may be caused by direct inoculation of pus, but there is good reason to believe that not an infrequent source of infection is by means of barley and other grains. There is reason to believe that it occurs in nature as a saprophyte. The history of many cases reported in man seem to indicate

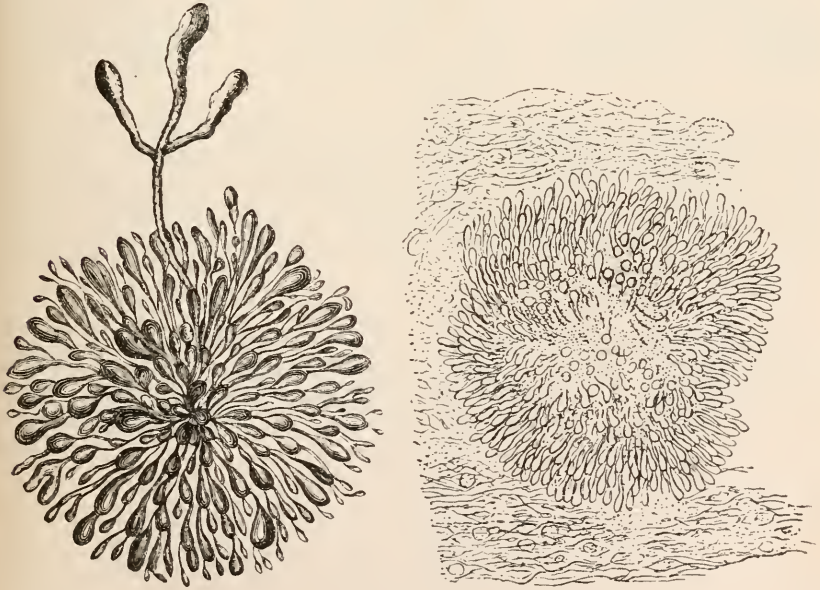

Fig. 30j. Lumpy Jaw *Cladothrix bovis* showing the radiating masses. At the left, the club-shaped bodies and branches (After Ponfick). At the right, one of the millet like bodies less magnified. After Flügge.

this kind of infection and it is a well-known fact that certain fields are the source of infection. Dr. McFarland says:

> When inhaled, the organisms enter the deeper portions of the lung and cause a suppurative broncho-pneumonia with adhesive inflammation of the contiguous pleura. After the formation of the pleuritic adhesions the disease may penetrate the newly formed tissue, extending to the chestwall, and ultimately form external sinuses; or, it may penctrate the diaphragm and invade the abdominal organs, causing interesting and characteristic lesions in the liver and other large viscera.

Another allied disease is the Mycetoma, or Madura-foot (*Cladrothix madureae*), which is found in India, especially in the province of Scinde, but occurs also in other parts of Asia, in Europe and northern Africa, and a few cases have even been reported in North America.

Another *Cladrothrix farcinica*, found in Guadaloupe country, is characterized by a superficial lymphangitis and lymphadenitis extending to the tracheal and axillary glands. The glands enlarge, suppurate, and discharge a pus. The internal organs have a pseudo-tubercular appearance.

The organism consists of long delicate filaments, characterized by distinct branching; the old cultures are rich in spores. The organism has been cultivated in the usual media.

It is pathogenic for guinea pigs, cattle and sheep. The culture is virulent for some time.

The papers by Nocard on the farcinica organism and a paper by Musgrove, Clegg and Polk on streptothrix should be consulted.

SCHIZOPHYCEAE

Unicellular organisms common in fresh and salt water. They contain blue, blue-green, violet, or reddish pigments; swarm spores absent; are common in fresh and salt water; simple in structure; existing as a single cell or as a chain held together by a gelatinous envelope, or in small colonies; chlorophyll and other pigments not in definite bodies but distributed throughout the cell-contents or else forming a sheath which lines the cell-wall; reproduction occurs by simple division; some forms produce spores which are thick walled thus enabling the organism to live over unfavorable conditions; after a period of rest these spores germinate and again reproduce in the vegetative way by fission or division. Some of the more common, more or less injurious types found in water are *Oscillatoria, Anabaena, Clathrocystis* and *Nostoc*. Cells contain *phycocyanin* and *chlorophyll*, the latter not visible because of the former.

CHROOCCACEAE

Cells spherical, singly or collected in colonies surrounded by a copious covering of mucilage forming gelatinous colonies of various sizes. The genus *Merismopedia* consists of flat rectangular colonies. Cell-division occurs in two directions. The genus *Gleocapsa* has spherical cells united into colonies, the cell with a thick colorless, brown yellow or violet coat. Some of the species are common in fresh water.

Clathrocystis. Henfrey

This alga occurs in colonies which are at first solid, but later become perforated. The colonies are held together by a gelatinous matrix. The cell contents are blue green, or rose-purple in color. The species most commonly found is the *C. aeruginosa*, occurring not only in Europe, but very widely scattered in

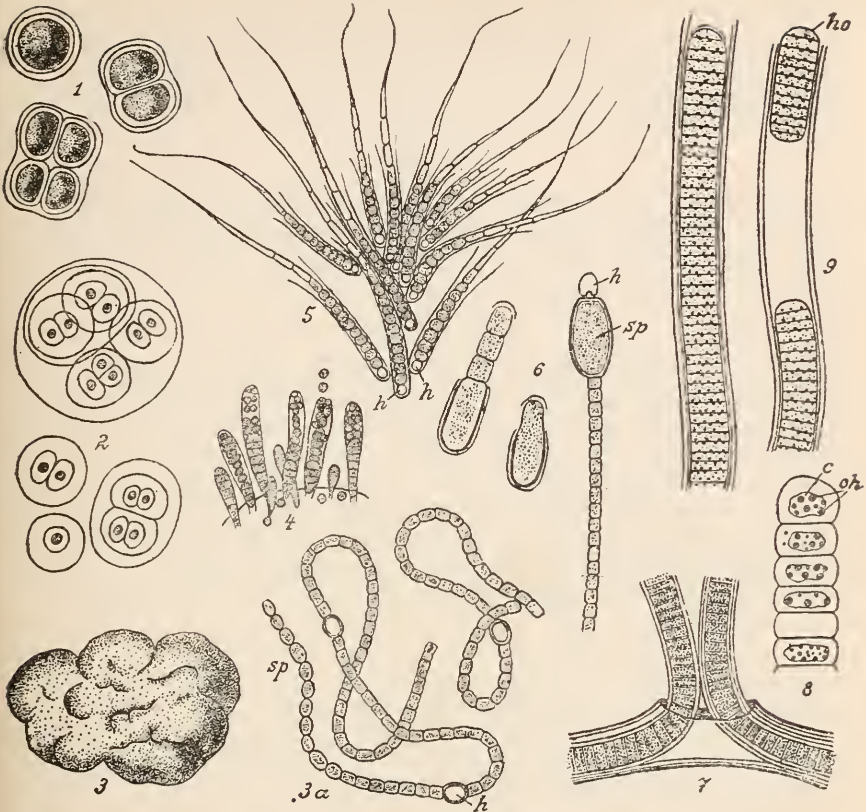

Fig. 31. Schizophyta. Schizophyceae. Blue Green Algae. 1. *Chrococcus turgidus* x 400. 2. *Gloeocapsa sanguinea* x 400. 3. *Nostoc verrucosum*. 3a. A pair of chains. 4. *Chamaesiphon confervicola* x 400; at the right, a caenobium; at the left, germinating arthrospores. 5. *Rivularia minutula* x 200. 6. *Anabaena macrosperma* x 100; at the right, a caenobium; at the left, germinating arthrospores. 7. *Plectonema Tomasinianum* x 200. 8. Filaments of *Tolypothrix aegagropila*; c—central body, ch—chromatin bodies, x 100. 9. *Lyngbya aestuarii* x 150; at the right filiaments with hormogonia (ho). In all figures, sp—spores, h—heterocyst. Fig. 1, 2, 3, after Cooke; Fig. 4, 5, 7, after Hausgirg; Fig. 8, after Nadson; Fig. 3a, 6, 9, after Wettstein.

North America, especially common in ponds and the plankton of lakes. Other species are *C. roseo-persicina* and *C. Kützingiana,* the former being especially common in ponds and ditches which contain a great deal of decaying vegetable matter. The latter species is now generally referred to the genus *Coleosphaerium,* and the *C. aeruginosa* to the genus *Microcystis.*

OSCILLATORIACEAE

Cells in filaments, apical cells disc-shaped with sheaths variable, sometimes wanting, heterocysts absent; form hormogonia. Common representatives, *Oscillatoria* and *Lyngbya* which at times are common in fresh water.

Oscillatoria, Vauch

The plant consists of more than one cell forming a simple filament held together by a common but stout gelatinous sheath, the cells being packed together like a row of lozenges. A few of the cells fall out of the sheath forming what is called a hormogonium. This starts a new filament which has a characteristic movement hence the name *Oscillatoria*. *Oscillatoria* is common in hot springs sometimes also covering damp soil in greenhouses. It is mainly through decomposition that these algae become noxious.

NOSTOCACEAE

Cells spherical in unbranched chains frequently torulose; sheaths gelatinous frequently forming jelly-like masses; reproduction by hormogonia and spores. Many species of the order are troublesome in water supplies. Some species of the genus *Nostoc* are used as food.

Nostoc, Vaucher

Colonies in flexuose chains united in definite gelatinous investment; cells usually spherical or ellipsoidal; heterocysts terminal or intercalary; spores spherical or oblong. These algae are very common in the lakes in southern Minnesota, Northern Iowa, and elsewhere in the United States. By decomposition, *Nostoc* produces disagreeable products. Dr. Arthur, some time ago, found *Nostoc* in quantities in the lakes of southern Minnesota and at one time it was supposed one species produced poisoning of cattle. Dr. Arthur, however, did not attribute the poisoning to this alga. One of the species of this genus frequently found is *Nostoc verrucosum* common in both the Old and New World.

Anabaena, Bory

Filaments straight or curved, surrounded by a thin sheath united to form a flocculent mass; heterocyst and spores intercalary. This alga also forms filaments which are free or united in a mass. In the filaments occur the vegetative cells, the heterocysts, whose function is not known, and a spore which serves to start the organism again. This organism causes much annoyance in water, not only in North America but in Europe. Dr. Farlow some years ago referred to its injurious properties. It has also been frequently mentioned by Parker as contaminating water supplies in Massachusetts; others have noticed it in New York, and Dr. Trelease has found it in Madison, Wisconsin. The latter writer says in speaking of the Waterbloom and other algae:

> After a warm spring, on my return to Madison, June 26, 1887, I observed a considerable quantity of putrid scum on the shore of Fourth Lake, but the south wind scattered it before specimens of it could be obtained. The succeeding fortnight was hot, and after a couple of calm days, succeeding a strong wind from the north-west, the southern half of the lake was filled with suspended particles about a millimeter in diameter. These consisted exclusively of *Anabaena Hassallii*, already in full fruit; the spores were the customary Sphaerozyga arrangment, in a collection made June 20th.

This algae is common in many of our northern lakes and is a frequent pest in water reservoirs, producing pig-pen odors and bad taste of water.

RIVULARIACEAE

Filiform filaments attenuated from base to apex, heterocysts basal or rarely absent; sheath tubular, gelatinous, or membranous .

Gloeotrichia, J. Ag.

Free floating colonies solid when young but inflated and hollow when old; the filaments radiating from the centre outwards.

Gloeotrichia Pisum, (Ag.) Thur.

It forms small green spherical bodies about 1 millimeter in diameter, floating at various depths in the water. It consists of a mass of tapering threads arranged radially in the gelatinous matrix. The apices of the threads protrude more or less, giving it a bristly appearance. The base of each filament contains a heterocyst and above it a slender cylindrical spore and beyond it the ordinary vegetative threads of the alga.

According to Dr. Arthur it is common in Minnesota. He found it common in Waterville, Lake Minnetonka, Lake Phelan in Minnesota and East Okoboji Lake in Iowa. It was thought by the people of Waterville, Minnesota, that this alga caused the death of cattle which drank the water. The history of these cases is recorded by Dr. Arthur as follows:

> "That some of the animals had drunk of the water and scum a few hours only before they died was positively known, and that all had done so seemed from circumstances quite probable. After the most careful examination the only plausible hypothesis that could be advanced to account for the death of the animals was that tbe alga present possessed some toxic or other baneful properties sufficiently powerful to kill a cow in a half hour or more after drinking freely of it. The well-established reputation of all the algae for innocuousness made this hypothesis appear from the very first extremely improbable, but for want of the slightest hint in any other direction it was thought worth while to bear it in mind, and to investigate the matter further.
>
> About the middle of June, 1884, word was received that eight cattle had died on the shore of Lake Tetonka. I at once started for Waterville, arriving on the twentieth and found the algae less abundant than in 1882, but still making the water green some fifty feet or more out from the shore toward which the wind had been blowing several hours. Altbough the conditions were not the most favorable, yet it seemed best to attempt a direct experiment by giving the animals water charged with algae. After much delay the services of Prof. M. Stalker, state veterinarian of Iowa and professor of veterinary science in the Iowa Agricultural College, were secured to conduct the experiment. A horse and calf were employed. On June 30th, Prof. Stalker, with the assistance of Prof. Edward D. Porter of the university of Minnesota, and in the presence of citizens of Waterville, made the tests, the writer being unable to remain. The animals had not been permitted to drink for some twenty-four hours previous, and were consequently thirsty enough to take a large amount of water well charged with the algae. No bad results of any sort followed.
>
> The thorough and able manner in which the test was made leaves no reasonable doubt of the perfect harmlessness of the algae in a growing condition. I append this last clause, because the citizens of the place still believe that the algae are at the root of the trouble, and that the test did not sbow it because they were not made at the rigbt stage of their occurrence. Although no sufficient study of the habits of this plant has yet been made to enable one to speak with certainty, yet it does not appear from present data that in some other stage it would give different results, unless it be when decaying, when it turns brown or reddish brown and gives off a peculiar stench. At this time the microscope shows the cells of the algae to be swarming with bacteria. Whether these are other than the common and harmless bacteria of putrefaction it is at present impossible to say. The probabilities are, however, entirely against the hypothesis that the decaying algae or the accompanying bacteria have anything to do with the trouble.
>
> We are therefore obliged to sum up the economic part of this investigation by stating that the deatb of the animals is probably not due to the suspected algae, and that no clue to the real cause has yet been obtained."

Dr. Arthur in a recent communication states that he has had no evidence so far that these algae are poisonous. That the death of these animals was probably due to bacteria found in the marshes.

OTHER BLUE GREEN ALGAE

Quite a number of additional genera are known to occur in our fresh waters; among them the *Gloeocapsa* with cells single or in groups surrounded by a gelatinous envelope, cell contents bluish green, brownish or reddish; *Merismopedia*, with division in two directions, cells arranged in tabular groups of 4, 8, 16, 32, 64, 128, etc.; *Lyngbya*, with filaments enclosed singly in a sheath, branchless or occasionally branched, cell contents blue and granular.

FLAGELLATAE

One-celled organisms with nucleus, sharply differentiated protoplasmic body, some with a simple membrane, pseudopodia absent, motile during most of their existence; cilia 1 or more and with 1 or 2 pulsating vacuoles; chromatophores occasionally absent; reproduction asexual by longitudinal division. The *Euglenales* contain the family *Euglenaceae*. The most common of these is the *Euglena viridis* which occurs in stagnant pools. Cells are elongated spindle-shaped, cilia 1 and with a red eye spot at one end. Water where these are abundant is not wholesome. The *Uroglena* forms small sphaeroidal nearly colorless colonies, the central portion of the colony is a hollow space filled with mucilage and the ciliated cells are arranged around the periphery; vegetative multiplication occurs by simple fission and by zoogonidia. The *Uroglena*, when occurring in large quantities produce a fishy, oily odor. The related *Synura* produces an odor of ripe cucumbers with a bitter and spicy taste.

EUPHYCEAE

Plants mostly occurring in water, always with a cell-membrane and nucleus. Green or other colors mixed with the green (brown or red). This includes all of the algae or thallophytes that contain chlorphyll which is, however, frequently masked because of other pigments like red and brown.

PERIDINIALES

Small 1-celled organisms of brown color, the chlorophyll masked by diatomin found mostly in the plankton of salt water.

BACILLARIALES

Small 1-celled organisms of brown color, the chlorophyll masked by diatomin of the chromatophores; cell-wall consisting of silica with a girdle and fine lines; reproduction asexual parallel to the long axis of the organism and the formation of auxospores and sexual auxospores by conjugation.

The diatoms are especially important in considering water supplies since they are widely distributed and at times very common. The diatom is like a pill box, made up of two parts, one fitting tightly within the other; the walls are strongly silicified and marked with fine lines; the cell contents are colored brown. Economically, these algae are of some importance as food for fishes, in manufacture of dynamite, and for polishing.

Dr. Moore, speaking of Diatoms in water says:

> There are only a few species which are known to give rise to serious trouble in water supplies, but these occur quite frequently and in great quantities. Sometimes the infected water has an odor, variously described as resembling fish or geraniums, and the taste is disagreeable enough to render it quite unfit for use. This condition is often produced by *Asterionella*. In addition to this effect, however, diatoms are extremely troublesome when contained in water to be used for the manufacture of paper or for laundry purposes, because

of the greenish-brown coloring matter they contain, which stains articles coming in contact with it. Whipple has observed that the growth of diatoms seems to depend upon certain definite conditions of the water—that is, they do not develop when the bottom of the pond or reservoir is quiet; but in spring and fall, when the rising or lowering temperature causes the water to circulate and a good supply of air and nitrates is obtained, the growth is most luxuriant. Thus, it is seen that temperature is only an indirect cause, and not one that need be taken into account by itself.

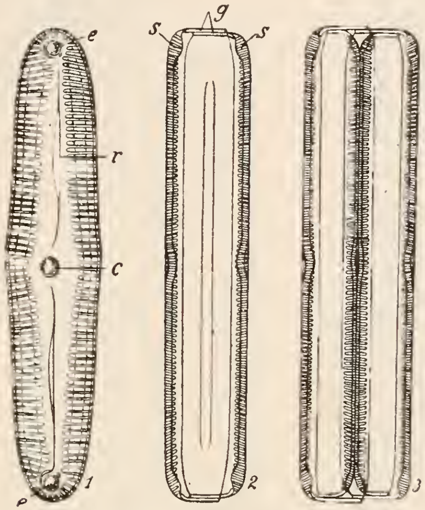

Fig. 32. Diatoms. *Pinnularia viridis.* 1. View showing markings in wall, c—central nodule; e—polar nodules; r—raphe. 2. Girdle view, s—silicified cell walls; g—girdle bands. 3. In process of division. Fig. 1 and 2 after Pfitzer; Fig. 3 after Wettstein.

CONJUGATAE

Chlorophyll-green algae, membrane without silica; reproduction, swarm cells absent; sexual reproduction by forming zygospores through the union of aplanogametes.

DESMIDIACEAE

The desmids are green unicellular organisms represented by such genera as *Cosmarium*, and are found mostly with other algae. They are not especially troublesome. Common genera are *Closterium*, *Cosmarium*, and *Desmidium*.

The filaments of *Zygnema* are small consisting of a single series of cylindrical cells placed end to end, occasionally with a slight constriction at the points of junction. Each cell has two star-shaped chloroplasts, each one containing a large pyrenoid.

Spirogyra, Link

Spirogyra is a common alga everywhere in our fresh waters, especially in quiet waters as in ponds and ditches. The filaments are simple, occur in bright green masses, often several feet long; cells cylindrical, variable in diameter and relative length; wall smooth and slightly gelatinous; chlorophyll arranged in

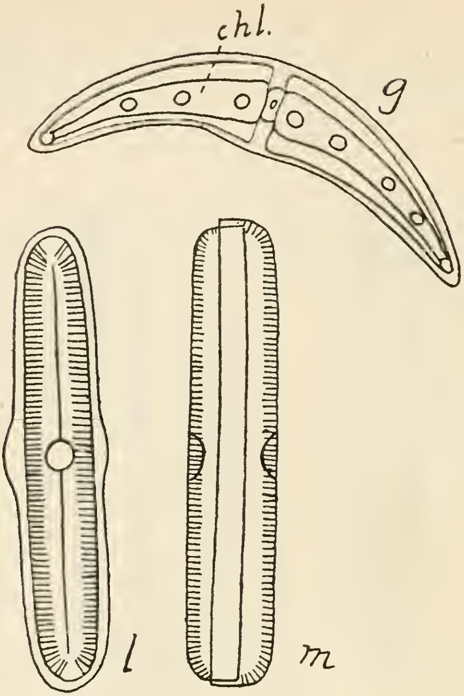

Fig. 32a. Lower figure, two views of diatom. *m* lateral view; *l* upper view. Upper figure, a desmid *Closterium*; *chl*—choroplastid. Charlotte M. King.

1 or more spiral bands, depending upon the species; nucleus is generally situated in the central portion of the cell; in the chlorophyll band occur what are known as the pyrenoids; reproduction both asexual, by the simple cutting off of the end cell, and sexual, by conjugation through the union of two cells.

ZYGNEMATACEAE

Cells cylindrical, unbranched forming threads, chromatophores present, in masses or spiral bands. Formation of zygospores.

CHLOROPHYCEAE

Chlorophyll-green plants, occurring singly or in colonies, (threads or flattened bodies) with one or more nuclei; reproduction asexual by producing multilateral zoospores and aplanospores; sexual by the copulation of zoogametes, or spermatozoids and oospheres; the spores produce a new plant directly or generally form swarm spores. Water net (*Hydrodictyon reticulatum*), *Pediastrum* and *Scenedesmus* are common in fresh water; *Pleurococcus* is common on trunks of trees. The *Confervales* contain the sea lettuce, *Ulva latissima,* which is used as food, the *Conferva* with slender green filiaments common in fresh water, the *Cladophora fracta* in fresh water. *Cladophora* is a common alga and is quite rough to the touch, and may therefore easily be distinguished from *Spirogyra* or *Zygnema.* The frond of *Cladophora* is branched, with many-

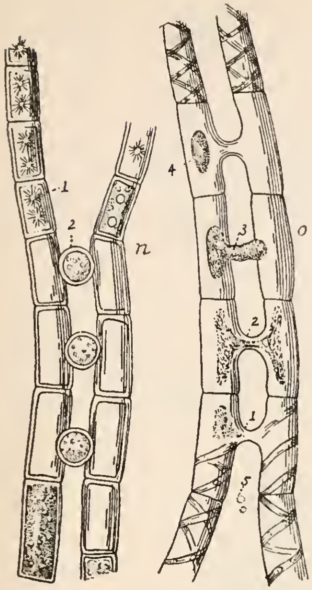

Fig. 33. Fresh Water Green Slimes. Conjugatae. Left hand figure; n—Zygnema. 1. Stellate chlorophyll grain. 2. Zygospore. Right hand figure., s—Spirogyra chlorophyll in a spiral band. 1, 2, 3 and 4, in different stages of conjugation. 4. Zygospore.

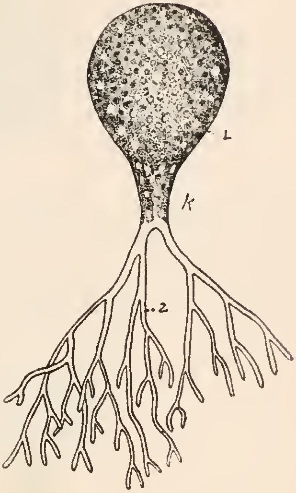

Fig. 33a. Botrydiaceae. Green Scum. *Botrydium granulatum.* 1. A single large zoosporangium. 2. Rhizoid process.

nucleated cells or, in some instances, only 1 or 2; chloroplasts occur on the margins with a single pyrenoid in each piece of the reticulum. The *Siphoneae* contain the *Vaucheria,* found in damp ground, the long unsegmented threads of which produce antheridia and oogonia, and the *Botrydium granulatum* found on damp ground.

VOLVOCACEAE

Unicellular organisms or forming colonies, each cell with a single chromatophore; forms gametospores and oospores.

Pandorina, Bory

The algae of this genus are collected together in spherical or subspherical colonies known as caenobia. Each caenobium contains about 16 cells closely packed within a gelatinous envelope; the cells are pyramidal in shape and reach almost to the center of the spherical colony; each cell produces 2 cilia.

Volvox, (L.) Ehrenb.

Volvox consists also of globose colonies known as caenobia, each consisting of a large number of small cells from 200 to 22,000, arranged in a single layer within a gelatinous sheath; the caenobium is a hollow sphere, the cells being connected by protoplasmic threads of varying stoutness; each cell has a distinct chloroplast, 2 or more contractile vacuoles and a number of cilia; reproduction occurs through asexual methods or by fertilization; in fertilization, the sperm

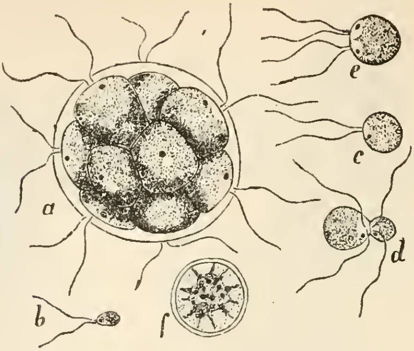

Fig. 34. Chlorophyceae. Pond Scum. *Pandorina Morum.* a. Floating caenobium. b and c. Zoospores. d. Zoospores conjugating. e. Process of conjugation complete. f. Zygospores. After Luerssen.

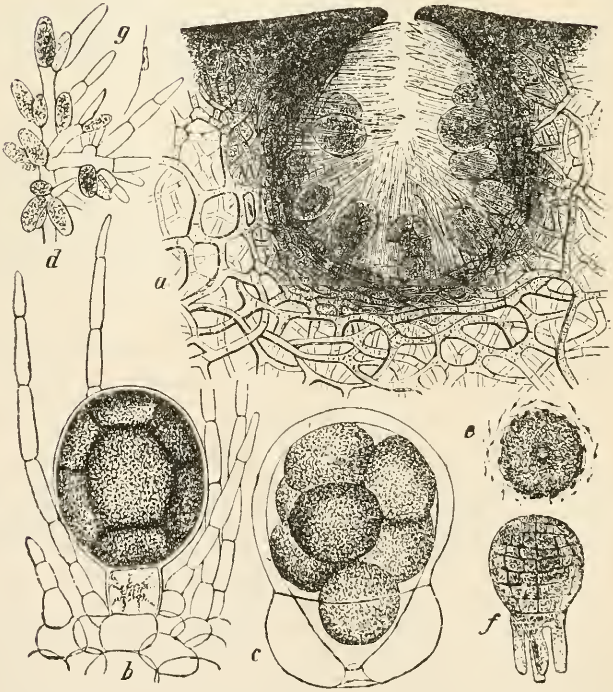

Fig. 35. Bladder Wrack. *Fucus vesiculosus.* *a.* Section through conceptacle containing oogonia. *b.* Single oogonium with egg cells. *c.* Egg cells escaping. *d.* Antheridium with sperm cells. *e.* Egg cells in process of fertilization, surrounded by sperm cells. *f.* Germination of spores, rhizoid below. *g.* Single sperm cells. After Thuret.

cell, coming from the antheridium, unites with the egg cell which is contained in the oogonium; the caenobium because of the cilia has a rolling motion. Several species are common like *V. globator* and *V. minor.*

Eudorina, Ehrenb.

The caenobium is globose or subglobose rarely ellipsoid and normally consists of 32 cells arranged within the periphery of a copious mucilaginous mass; each cell contains 1 or more pyrenoids; reproduction takes place as in *Pandorina. Eudorina* like *Pandorina* produces a faintly fishy odor.

CHARALES

Plants of brackish or fresh water, consisting of internodes; short whorls of cylindrical branches; cells nucleated; growth from an apical cell; asexual reproduction by means of bulbils and vegetative threads; sexual reproduction by egg-cells and spermatozoids, the latter spirally coiled in the cells of the

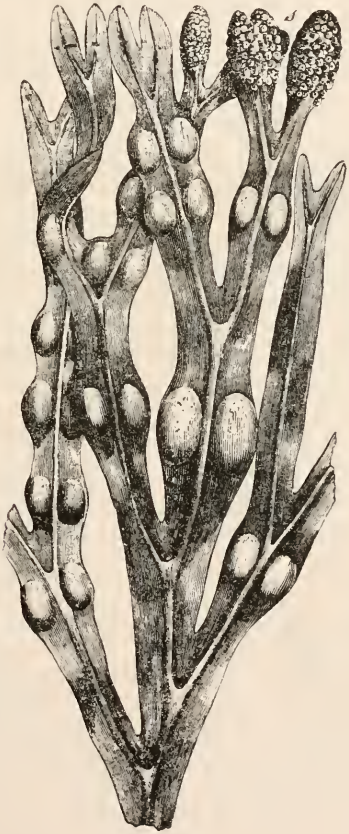

Fig. 36. Bladderwrack. *Fucus vesiculosus.* Air spaces shown in light areas (*l*); conceptacles (*s*) containing reproductive bodies. After Luerssen.

antheridium; the egg cell is contained in a spirally coiled oogonium and after fertilization becomes an oospore. The Stoneworts or Charas are common in brackish water, and though not injurious frequently stop up canals and fill ponds so that it becomes necessary to pull them out.

PHAEOPHYCEAE

Brown algae; chlorophyll marked by a brown coloring matter, *phycophaein,* reproduction sexual and asexual, swarm spores, sperm cells and egg cells: marine; tetragonidia absent.

The Phaeosporeae contain the *Laminariaceae*; the Devil's Apron, *Laminaria digitata,* and other species from which iodine and mannite are derived. The *Macrocystis pyrifera* is of great length. The Clyclosporeae contain the family *Fucaceae,* the common Bladderwrack (*Fucus vesiculosus*) from which iodine, bromine and soda are obtained. The Sargasso weed (*Sargassum bacciferum*) found in the Atlantic ocean is also abundant in the Sargasso Sea.

DICTYOTALES

Brown algae; reproductive bodies without motion; tetragonidia present. This group contains a single order Dictyotaceae comprising a few genera.

RHODOPHYCEAE

Red or violet algae; chromatophores contain chlorophyll and red coloring matter (phycoerythrin and rhodophyll); reproduction sexual and asexual; mostly marine. The red sea weeds are divided into several classes and numerous orders. The sub-class *Florideae* contains most of the species. Food is obtained from several species and the carrageen is furnished by *Chondrus crispus,* agar agar is obtained from *Gracilaria lichenoides* found in the Indian Ocean. The *Gloiopeltis coliformis* and other species are used by the Japanese as food. Many of the species are pretty and are much gathered on the sea coast.

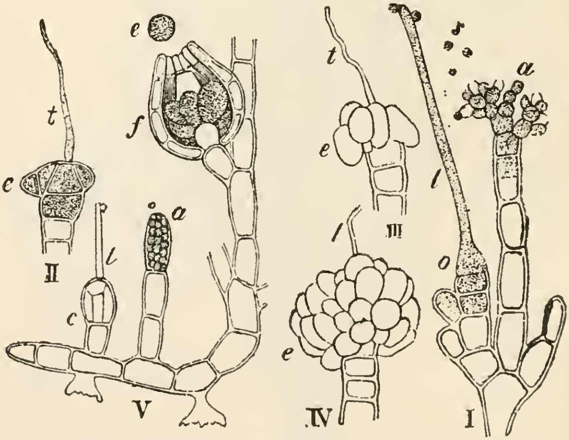

Fig. 37. Red Sea Weed, *Nemalion multifidum.* 1. Branch with carpogonium and antheridium. 2-4. Different stages of development. 5. *Lejolisia mediterranea* with antheridium, carpogonium and spores. *a*—antheridia, c and *o*—carpogonia, *t*—trichogyne, *s*—sperm cells, *e*—spores, *f*—fruit. After Thuret and Bornet.

EUMYCETES

Parasitic or saprophytic plants with one or more cells, chlorophyll absent with apical growth; mycelium usually evident; reproduction sexual and asexual, generally the latter; asexual by the formation of zoospores, conidia or spores.

PHYCOMYCETES

Thallus generally of a single branched tubular thread; septa in connection with the reproductive bodies only; threads containing many nuclei; reproduction sexual and asexual, in the latter the spores generally in sporangia (*Mucor*); conidia in chains (*Albugo*), or at the end of the hyphae (*Plasmopara*); reproduction sexual by copulation forming zygospores (*Mucor*) or oospores in *Plasmopara* and *Albugo*.

ZYGOMYCETES

Parasites or saprophytes; mycelium branched not septate, or septa in connection with the formation of the reproductive bodies; reproduction sexual by endospores, acroconidia, or chlamydospores. A group of fungi represented by the Fly Fungus (*Empusa*) and Common Black Mould (*Mucor*).

MUCORACEAE

Sporangia with columella, many spored, zygospores between the threads of the mycelium. Few species have the two sexes united on the same plant; generally they are on the separate individuals. According to Blakeslee, *Sporodinia* contains both sexes (homosporangic, homosporic, homophytic and homothallic). *Phycomyces* is dioecious, the zygospores producing at germination but one kind of germ tube which gives rise to a sporangium containing both male and female spores, (homosporangic, heterosporic, homophytic, heterothallic) *Mucor mucedo* has sexes separated on different individuals but two different kinds of germ tubes are formed by the germination of the zygospores, (heterosporangic, heterosporic, heterophytic, and heterothallic). Zygorrhynchus is heterogamic. The same author* has recently reviewed the literature.

About 85 species widely distributed. The Phycomyces was first found in oil kettles, and not infrequently in oil cakes. *Sporodinia* are parasitic on larger fungi. *Pilobolus crystallinus* is common on horse manure, the conidiophore being enlarged. The sporangia look like "fly specks" on the wall. This fungus is not injurious.

Mucor (*Micheli*) Link. Mucor. Mould

Mycelium creeping, conidiophores simple or branched; sporangia spherical or pear-shaped; columella well developed, wall of sporangium mucilaginous, in some cases chlamydospores, or forming small chains or "cysts"; zygospores produced by the fertilization of two gametes.

A genus of wide distribution of 50 species. The life history of a common species, the *Mucor stolonifer* (*Rhizopus nigricans*) found on bread and decayed fruits is as follows. The gray felted mycelium spreads through the substratum, and on the surface small black bodies, the sporangia, are produced. The conidiophore arises from the felted mycelium and bears an enlarged spherical head, the sporangium, within which, occur the spores. On adding water

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* Bot. Gazette *1909*:418. Reprint.

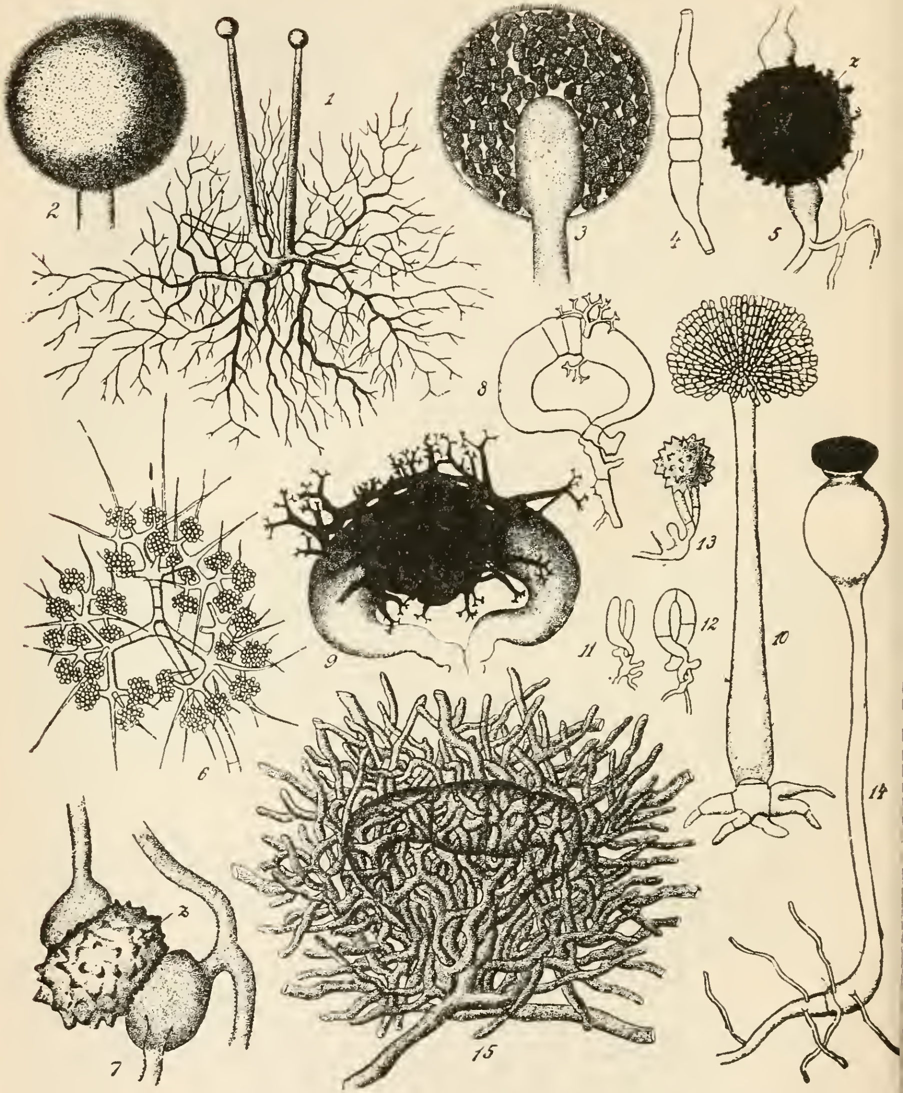

Fig. 39. Black Moulds. *Zygomycetes*. 1-5. *Mucor mucedo*. 1. Mycelium and young sporangium x 25. 2. Ripe sporangium x 100. 3. The same in optical view x 100. 4. In process of fertilization x 80. 5. Zygospore (*z*), greatly magnified. 6-7. *Chaetocladium Jonesii*. 6. Conidia x 150. 7. Zygospores. 8-9. Fertilization and formation of zygospores in 9. 10. Conidiophores of *Syncephalis intermedia* x 100. 11-13. Fertilization and formation of zygospores in *S. cornu* x 300. 14. Conidiophore, gelatinous enlargements and black sporangium of *Pilobolus crystallinus* x 30. 15. Fertilization of *Mortierella Rostafinskii* x 300. 1-7, 14-15 after Brefeld, 8-13 after Van Tieghem.

to the specimen, the wall of the sporangium collapses and the end of the stalk, known as the columella, turns back, giving it something of the appearance of an umbrella. The columella, before it collapses, projects into the sporangium.

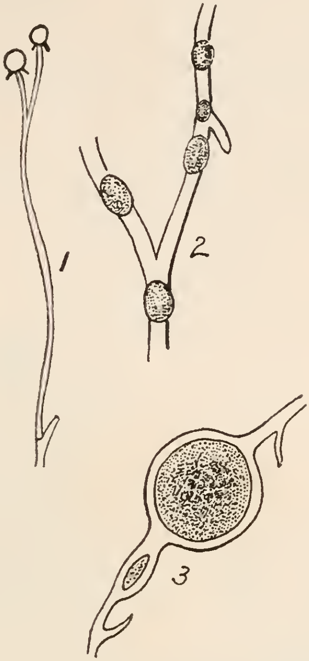

Fig. 40. *Mucor Rouxii.* Conidiophore. 2. Gemmae. 3. Chlamydospores. All greatly magnified. 1 after Vuillemin. 2 after Calmette. 3 after Wehmer. (Modified by Charlotte M. King).

The spores germinate readily when placed in a moist atmosphere. In addition to the production of a sporangium a stalk may bend over and cause the further extension of the fungus by producing what is known as a stolon.

In some species small, round, or elongated spores are produced in the mycelium which are known as chlamydospores, and spread the fungus. In addition to the formation of spores in the sporangium, zygospores are produced in some species; two threads of the mycelium lie in proximity and nearly parallel, each produces a tube; these meet, the walls are absorbed, and, just back of the meeting point, a cell is cut off. The contents from the old cells pass into the newly formed cell. We also observe that the cell of one arm is somewhat smaller than that of the other. This spore is a resting spore or zygospore. It lies dormant for a period, then germinates by forming directly a coniodiophore with its sporangium containing the spores.

Prof. Blakeslee has shown with reference to the fertilization of some of the species of Mucor that it requires a male and a female plant. In speaking of *Mucor mucedo* he says:

> *Mucor mucedo* has the sexes separated on different individuals as in *Phycomyces*, but two different kinds of germ tubes are formed by the germination of its zygospores. While some

germ tubes are male and produce only male spores, others are female and produce only female spores in the germ sporangium. The sporophyte as well as the gametophyte, therefore is unisexual.

"Raggi," used in the manufacture of Arrack, contains *Mucor Oryzae* (*Rhizopus*) which transforms rice starch into dextrose, the latter being then fermented by yeasts forms blackish brown sporangia and has a pear-shaped columella. *Mucor Rouxii* of Calmette is commonly grown in China, where it is found on rice husks and is made from these into Chinese yeast. It changes rice starch into sugar and has been used to some extent for manufacture of alcoholic drinks.

M. racemosus, common in decaying fruit, produces alcoholic fermentation. *Mucor fusiger* is parasitic on species of Collybia; *M. Melittophtorus* was found in the stomachs of bees; *M. nigricans* was found by Neumann (1892) and later by Artanet (1893) in the eye of poultry but Barthelat does not consider it pathogenic.

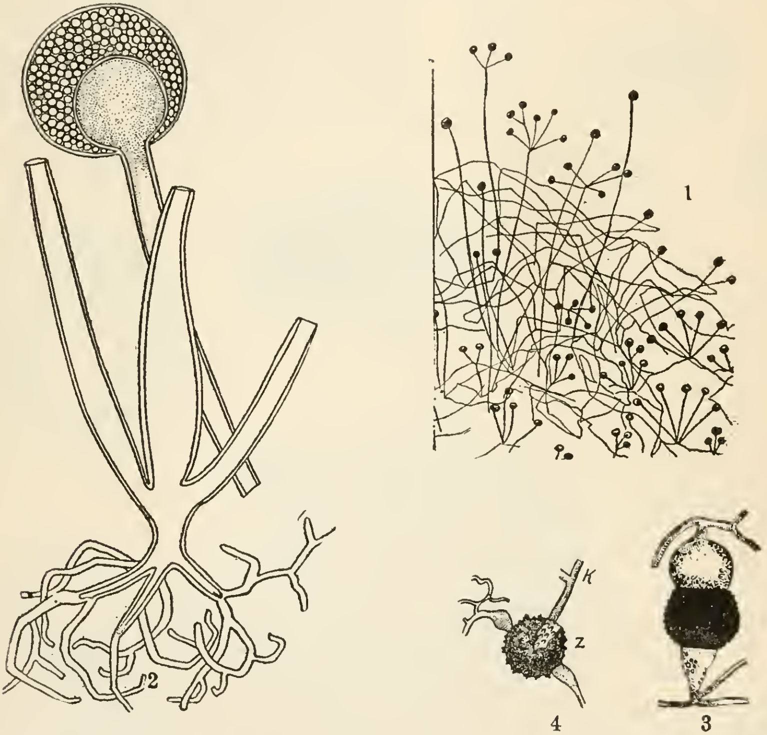

Fig. 41. Common Black Mould (*Mucor stolonifer* or *Rhizopus nigricans*). 1. Sporangia and method of spreading by stolons. 2. Same, showing rhizoids, conidiophore, columella, sporangium and spore. 3. Zygospore, showing method of conjugation. 4. Zygospore germinating; *k*, conidiophore.

Mucor corymbifer, F. Cohn.

Delicate, white mycelium spreading over the surface of the substratum; conidiophores appressed, spreading; branched sporangia in umbellate clusters, the lower sporangia smaller than the upper, the latter 70 μ diameter; wall

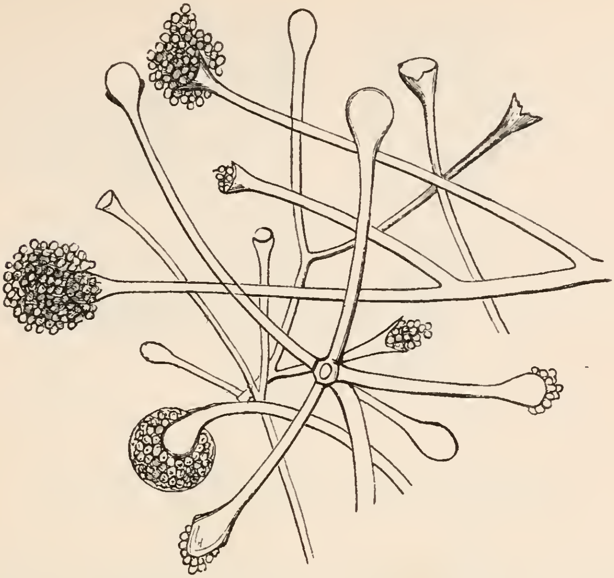

Fig. 42. *Mucor corymbifer* after the bursting of the sporangium. After Lichtheim.

colorless, smooth, collapsing; spores colorless, small 2 x 3 μ.; columella club-shaped, brownish frequently papillate.

Distribution. Probably tropical, found in tropical drugs, in Europe and the United States.

Pathogenic properties. Lichtheim recognized this species as pathogenic. It grows better at a temperature of blood. When introduced into the circulation of guinea pigs, it produces death in 48 to 72 hours. Mycelium is found in kidneys, spleen and Peyer's patches of intestines which are swollen and ulcerated. Huckel found the organism in the human ear. Dr. Wolffner in Dr. Trelease's laboratory in St. Louis, Mo., cultivated the organism from the human eye. The clinical record of this case was as follows: A farmer near St. Louis, was cutting corn with an old fashioned corn knife. A small piece of corn stalk flew into his eye, later inflammation set in followed by inability to see. Dr. Wolffner found a film over the surface. This film was removed and later *Mucor corymbifer* developed from it. It has been frequently found in ulcerated portions of the lungs, intestines, nasal cavity, and in the auditory canal. Dogs are immune.

The earliest recorded case of mucor in pneumonomycosis was made by Fürbringer, who had under observation three cases of a disease in two of which he found a Mucor. According to Dr. H. C. Plaut, the cases of otomycosis are not infrequent in India. According to Siebenmann it occurs in .5-1 percent in all diseases of the ear, and males, especially farmers and gardeners, are more predisposed than females. According to Hatch and Row, ear mycosis is common in India, they having observed 22 cases in one month. The most common fungi found in the ear are *Verticillium graphii, Aspergillus fumigatus, A. niger,* and *A. flavus. A. nidulans* is somewhat rare, as is *Mucor septatus.* The *Aspergilli* will be treated more at length in another connection.

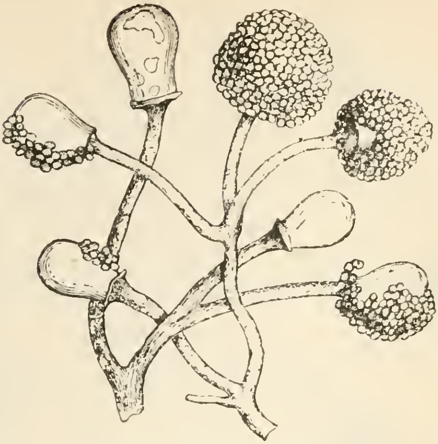

Fig. 43. Black Mould, *Mucor rhizopodiformis*. Branched conidiophores, large columella and discharged spores around the same. After Lichtheim.

Mucor Trichisi, Lucet and Costantin

This differs from *M. corymbifer* in a few characteristics of sufficient importance to cause Lucet and Costantin to consider it a distinct species, *M. Trichisi* having larger spores which are 4 μ in diameter and sporangia 35 μ in diameter. It was isolated from epidermal scabs appearing on a horse affected with tinea, produced by *Trichophyton minimum*. The *M. Regnieri* described by the same authors is similar to the preceding.

Mucor rhizopodiformis, F. Cohn

Mycelium at first snow-white then gray, conidiophore single or clustered, brownish, 125 μ long, small rhizoid processes, columella broad, constricted at the base; sporangia spherical, at maturity blackish, spores spherical colorless, 5-6 μ in diameter. Closely allied to *M. stolonifer* or *M. inaequalis*.

Distribution. Not uncommon on bread in Europe.

Pathogenic properties. Pathogenic like the preceding. When introduced into the circulation of guinea pigs it produces inflammation and the tissues of the spleen, liver and intestines are found to contain the mycelium of the fungus. The animal becomes inactive, lies on its side and drops its head. Small masses of the mycelium may be found in the kidneys.

Mucor pusillus, Lindt.

Mycelium spreading, with numerous chlamydospores which are capable of germination; conidiophores generally branched; sporangia spherical, brownish, 30-40 μ in diameter; spores ellipsoidal or spherical, 5-8 μ long, 3-5 μ in diameter; columella pear-shaped; zygospores seldom produced, spherical, 70-84 μ in diameter, roughened, chlamydospores abundantly produced: species capable of changing cane sugar into invert sugar, producing the ferment invertase.

Distribution, and hosts. Widely distributed in both Europe and North America, occurring on various decaying objects.

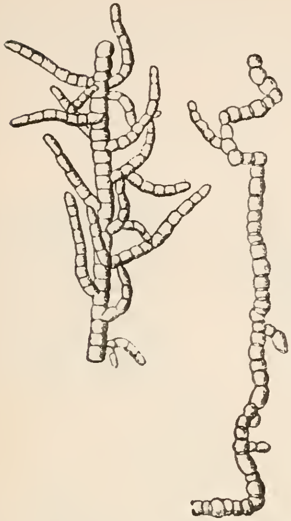

Fig. 44. *Mucor racemosus.* Fragment of mycelium, which has undergone conversion into chains of oidia x 120. After Brefeld.

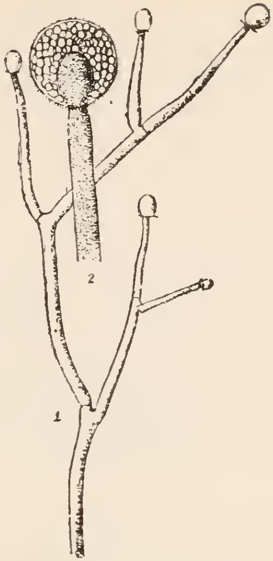

Fig. 45. Mould. *Mucor racemosus.* 1. Branched sporophore or conidiophore x 80. 2. Optical section of sporangium x 300. After Brefeld.

Pathogenic properties. Said to be pathogenic for various birds but Pierre Savouré, after some extensive experiments thinks that it plays no part in disease. It was not pathogenic for rabbits and guinea pigs. Bollinger states that it occurs in the respiratory tract of birds where it produces mucormycosis. It has been observed in cutaneous lesions in cavalry horses in France, although culture did not yield this fungus but yielded a trichophyte instead.

Mucor ramosus, Lindt.

Mycelium spreading in the substratum, small, branched, at first white then becoming grayish-white; sporangia black, spherical with marginal spines 60-80 μ in diameter; columella ovate, light brown, 50 μ wide; spores somewhat spherical, 3-3.5 μ in diameter, colorless.

Distribution and Habitat. Found in Europe, not abundant.

Pathogenic properties. Pathogenic for birds. Grows only at a temperature of blood, minimum 20-25° C., maximum 50-58°, optimum 45°.

Mucor ramosus, Lindt

Mycelium branching, abundant in the substratum and superficial conidiophores 5-15 μ wide; sporangia blackish, membrane but slightly colored, 70 μ in diameter; columella rounded at the end or blunt; spores colorless, with delicate membrane, smooth, 3 to 4 μ x 5-6 μ. This resembles *M. corymbifer* except in the character of the spores.

Pathogenic properties. Pathogenic for guinea pigs, death occurring in 30 to 36 hours.

Mucor septatus, Siebenmann.

Mycelium at first white, later grayish; sporangia light yellowish brown, sporangia small; colmuella colorless; conidiophore branched; spores small 2.5 μ in diameter.

Distribution and Habitat. Found in Europe.

Pathogenic properties. Pathogenic for human beings, found in the ear.

Mucor equinus. (*Costantin* and *Lucet*), Pammel

Mycelium branched, at first white or whitish, floccose with simple pedicels withous rhizoid processes, erect or suberect, becoming fascicled, hyphae 8-12 μ in diameter; columella spherical or subspherical 20-50μ in diameter; spore roundish or slightly angular smooth 4 μ in diameter, chlamydospores numerous especially at blood temperatures.

Distribution. First found in Europe.

Pathogenic properties. Found in horses. Guinea pigs and rabbits inoculated peritoneally die on the 5th or 6th day.

Mucor parasiticus (Lucet and Costantin), Pammel.

Mycelium spreading, branched, brownish fawn color producing stolons and rhizoids; sporangia-bearing peduncles branched; conidiophores 12 to 14 μ wide 1-2 cm. long; columella ovoid pyriform slightly brownish 7-30 μ high; sporangia 8 to 37 μ; lateral sporangia similar but smaller. Grows readily in nutrient media. The rhizoids sink into the substance, the simple conidiophores rise from the rhizoids. Lucet and Costantin placed this species in a new genus Rhizomucor.

Pathogenic properties. It is essentially parasitic and was isolated from

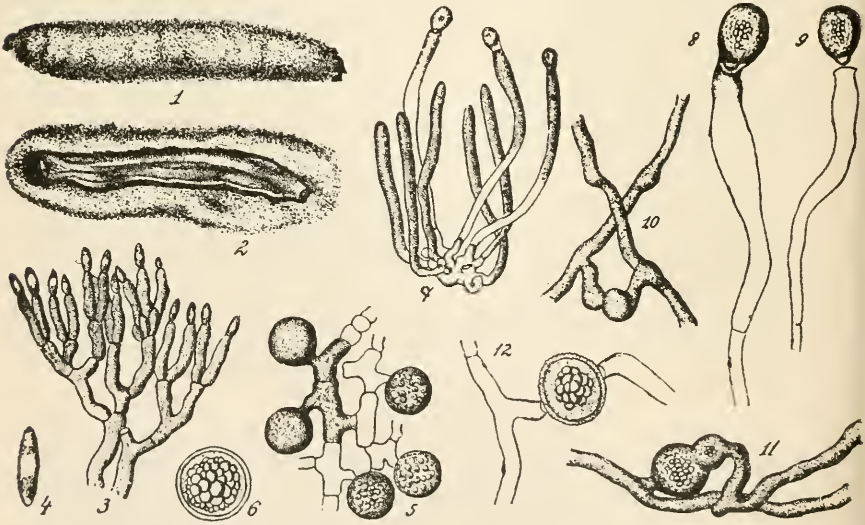

Fig. 46. Entomopthoraceae. 1-6. *Empusa sphaerosperma*. 1. Larvae of Cabbage Butterfly. 2. Sectional view. 3. Conidiophores and conidia x 300. 4. Conidium x 600. 5. Mycelium with zygospores x 350. 6. Single zygospore x 600. 7-12. *Conidiobolus utriculosus*; found on the gelatinous fungi like the Jew's Ear (*Auricularia*). 7. Conidiophore x 80. 8-9. Same, much enlarged. 9. Discharging conidium .10-12. Fertilization and forming zygospore. After Brefeld.

the sputum of a tubercular patient. It is pathogenic for rabbits and guinea pigs when inoculated. Lucet and Costantin think that cases of mucormycosis are more frequent than generally supposed. Meyer seems to have made the first observation of a Mucor in animals having observed it in the lungs of a jay. Heisinger in 1821 found a Mucor in the lungs of a goose.

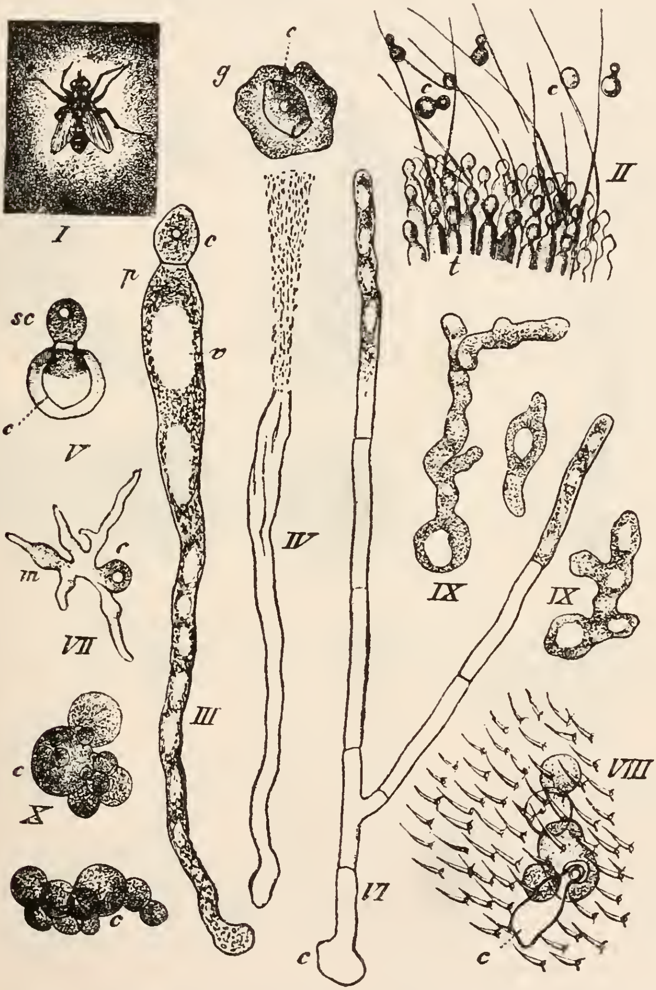

Fig. 47. Fly Fungus. *Empusa Muscae*. 1. Empusa on fly surrounded by a halo. 2. Part of body of fly; general fructifying part (*t*); conidia (*c*) and secondary conidia x 80. 3. Fully formed conidiophore with conidium (*c*) and vacuole (*v*) x 300. 4. Tubular conidiophore projecting a conidium (*c*) surrounded by part of the plasma (*g*) of the conidiophore. 5. Conidium (*c*) with a secondary conidium (*sc*). 6. Conidium (*c*) forming a mycelium tube 300. 7. Secondary conidium (*c*) germinating x 300. 8. Part of chitinous integument of fly with conidium (*c*) penetrating the integument x 500. 9. Fatty bodies of fly containing mycelium of parasite x 300. 10. Yeast-like sprouting cells (*c*) from the fatty bodies of a fly x 500. After Brefeld.

ENTOMOPHTHORACEAE

Mycelium abundant, generally parasitic on living insects; multi-nucleate, non-septate or may become septate; asexual reproduction by means of conidia which are cut off from the end of the sporophore; conidium with one or many nuclei; conidia forcibly ejected; sexual reproduction by means of zygospore; azygospores without fertilization also frequent. One of the most common species of this family is the House Fly Fungus *Empusa Muscae*. *Empusa sphaerosperma* is found on the larvae of Cabbage butterfly; *E. Grylli* is on the Rocky Mountain Locust and the *Macrospora cicadina* is found on the Cicada. *Basidiobolus ranarum* occurs on frog excrement.

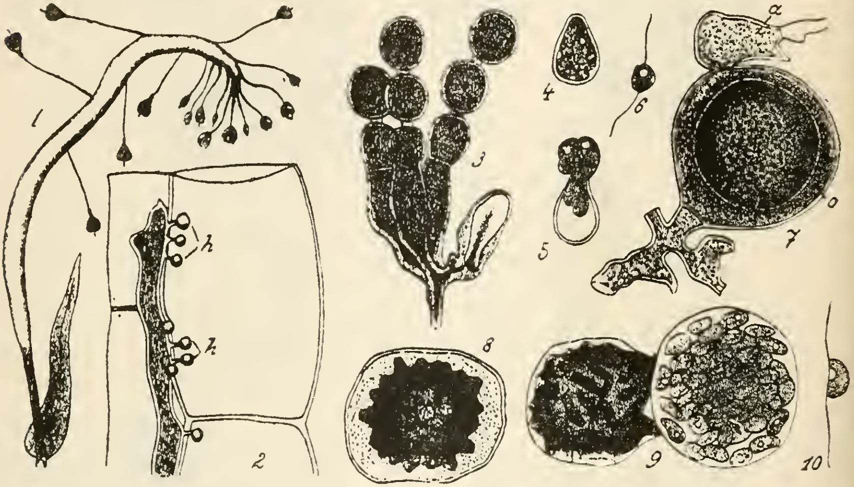

Fig. 48. Peronosporaceae. White Rust. *Albugo canida.* 1. Inflorescence of Shepherd's Purse with fungus. 2. Mycelium with haustoria (*h*) x 390. 3. Conidiophores and conidia (spores) in chains x 400. 4 and 5. Formation of zoospores in conidia x 400. 7. Oogonium (*o*) and antheridium (*a*) attached, mycelium shown below. 8. Oospore with thick wall. 9. Germinating oospore forming a zoosporangium. 10. Zoospore. 7-10x400. 6. Germinating Zöospore. After DeBary.

OOMYCETES

Mycelium occasionally sparingly developed, tubular, asexual; reproduction by swarm spores or conidia; sexual by the formation of oospores in the *Peronosporaceae* and *Saprolegniaceae*.

Synchitrium has a much reduced mycelium. Sexual reproduction found only in some of the genera of the family *Chytridiaceae*. The non-septate mycelium is reduced to a single sac shaped cell forming a kind of gall in the host plant. One species of *Synchytrium*, the *S. decipiens,* occurs on the Hog-pea (*Amphicarpaea monoica*).

The family *Pythiaceae* contains a destructive parasite of seedlings, the *Pythium DeBaryanum* and the *P. proliferum* upon dead insects in water.

ALBUGINACEAE AND PERONOSPORACEAE

Mycelium generally well developed. Reproduction sexual and asexual; in sexual reproduction oogonia and antheridia; asexual spores, conidia, or zoospores.

Many members of this group are destructive parasites to cultivated plants like the potato rot fungus (*Phytopthora infestans*), the onion mildew (*Peronospora Schleideniana*), the lettuce mildew (*Bremia Lactucae*), the mildew of the sunflower (*Plasmopara Halstedii*), the Clover mildew (*Peronospora trifoliorum*) which may be injurious to animals, the millet mildew (*Sclerospora graminicola*) which may also be injurious. As a type of this family the downy mildew of the grape (*Plasmopara viticola*) may be taken. It appears during the early summer and continues till frost. Leaves, berries and stem are affected. The upper surface of the leaf shows yellow patches, underneath a white frosty mould. A section through the leaf will show the mycelium vegetating between the cells. The mycelium gives rise to the fruiting branches of the fungus, the conidiophores, which pass out through the stomata. The conidiophores are dichotomously branched, and at their ends bear the conidia. When these conidia are placed in water they begin to change, at the end of an hour, they swell and the contents divide. According to Dr. Farlow "at the expiration of an hour and a quarter the segments had resolved themselves into a number of oval bodies" which before long succeeded in rupturing the cell-wall and making their escape from the mother cell. Each of these zoospores is provided with two cilia. In some, zoospores are not produced, but the whole mass passes out, which soon produces a tube. The zoospores produce germ tubes which probably pierce the leaf of the grape. The temperature most favorable for germination is between 25° and 35° C. Inoculation experiments with the grape vine mildew show that on the second day the disease appears. Sexual method of reproduction takes place later in the season and occurs in the leaf. A slight swelling appears at the ends of the branches of the mycelium, which is spherical in shape, the cell-wall being thick and pale yellow in color. The whole rounded mass is called the oogonium. The central part is the oosphere. A small body is developed from another (or the same thread) which lies along-

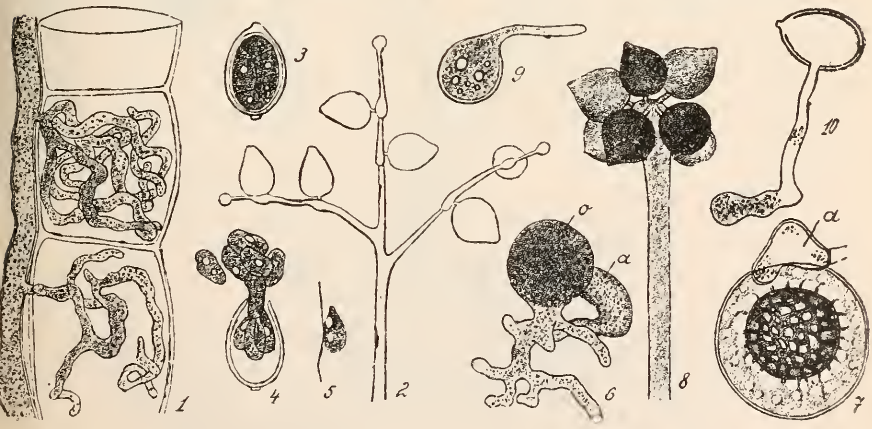

Fig. 49. 1. Downy Mildew. *Peronospora calotheca.* Mycelium between the cells sending haustoria into the cells, x 390. 2. Potato Rot Fungus (*Phytophthora infestans*), conidiophores, conidia borne on the branches. 3. Single conidium forming, zoosporangium and the zoospores. 4. Discharge of zoospores. 5. Single ciliated zoospore. 6. Oogonium (*o*) and antheridium (*a*). 7. Oospore and antheridium (*a*) of *Peronospora alsinearum* x 390. 8. Conidiophore and conidia of *Basidiophora entospora* found on leaves of *Erigeron* x 200. 9. Germinating conidia of *Bremia Lactucae* (the Lettuce Downy Mildew). 10. Conidium of *Peronospora leptosperma* germinating x 300. 1-7 9-10 after DeBary, 8 after Cornu.

side of the oogonium; the antheridium. This pierces the oogonium and the protoplasm of the antheridium passes into the oosphere.

In the species that have been studied like *Peronospora parasitica*, and *Albugo candida*, the oosphere or egg cell contains a single nucleus, situated about at the center, the remaining nuclei having passed into the peripheral layer of the protoplasm of the periplasm.

A single male nucleus passes from the antheridium into the egg cell and fuses with the nucleus of the egg cell. Numerous investigations in this line have been made by Stevens,* Berlese,† and Wager.‡ It is probable that the course of reproduction is similar for other species.

In fertilization karyokinetic changes occur. The protoplasm surrounding the oosphere is used to build up the wall of the oospore. Germination of oospore probably takes place in the spring. In Albugo or Cystopus the conidia are borne in a moniliform chain.

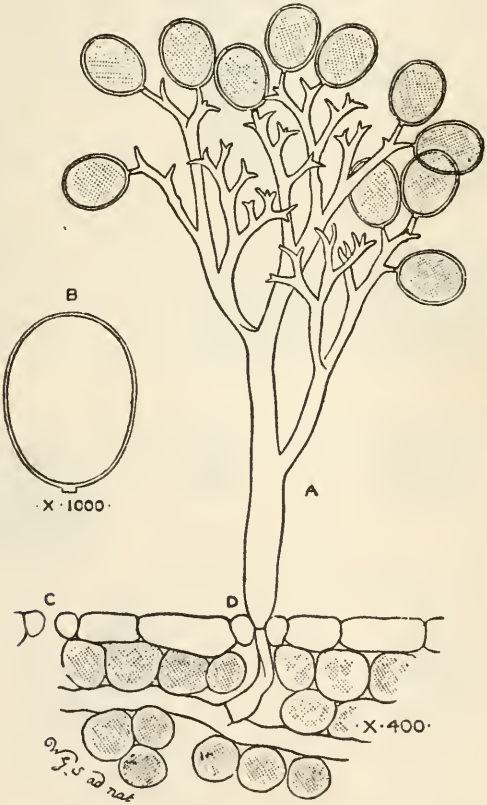

Fig. 50. Downy Mildew of Clover (*Peronospora trifoliorum*). *a.* Conidiophore. *c.* Stoma. *b.* Conidium; common in Europe on Red Clover, may be injurious to animals. After Smith.

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* Bot. Gaz. 28:149; 23:77; 34:420.
† Jahrb. f. wiss. Bot. 31:159.
‡ Annals of Bot. 4:127; 14:263.

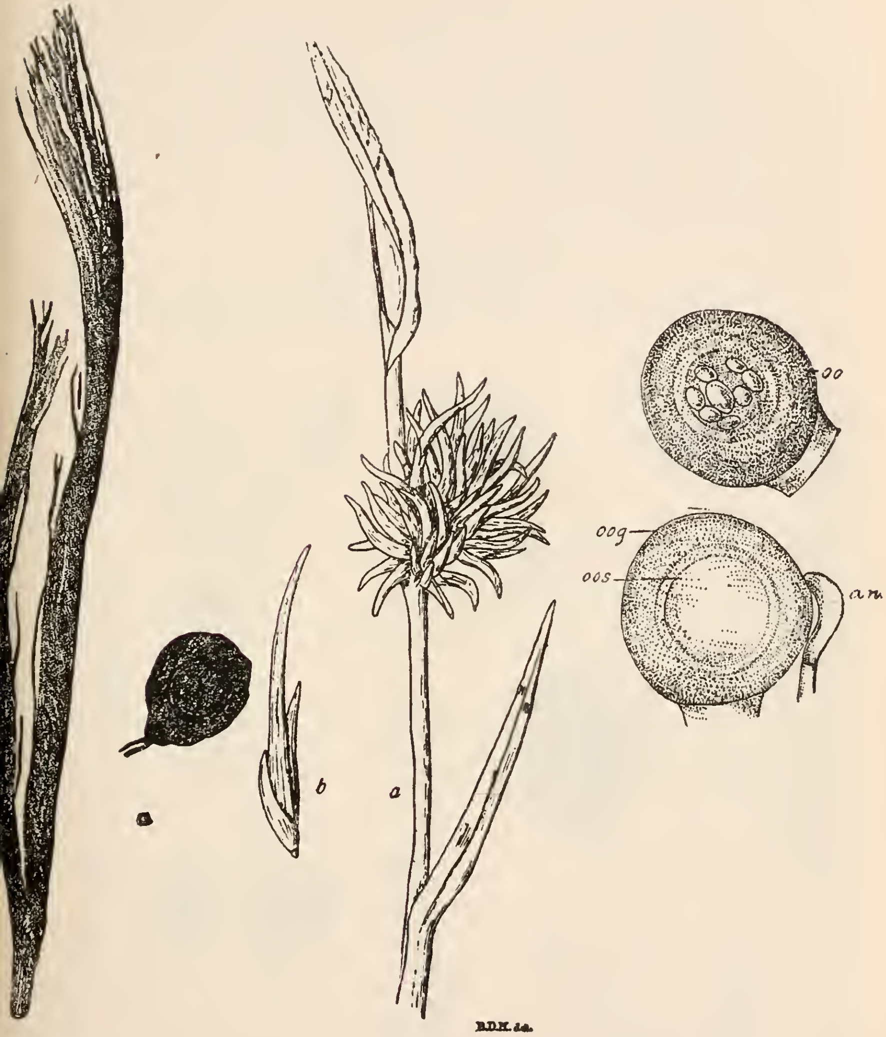

Fig. 51. At the left, leaf of Green Foxtail (*Setaria viridis*), containing the oospores of *Sclerospora graminicola*, a single spore at *a*. After Trelease. At the right, spike affected by the same fungus; *b* spikelet enlarged. The figure at the right, oospores from Hungarian grass; *oog*—Oogonium, *oos*—oosphere; *oo*—Oospore. The middle figure, Halsted; the right hand, Charlotte M. King.

In some forms the oospores are rare, and in the potato rot fungus they have apparently not been found. In some members of this group oospores are formed without fertilization, (Parthenogenesis).

Dr. G. P. Clinton,* who has made a careful study of the Lima Bean Mildew (*Phytopthora Phaseoli*) and the potato rot fungus (*Ph. infestans*) has been unable to find that the mycelial thread of the antheridium had the same origin as the one which bears the oogonium. It is possible that the fertilization is accomplished in a manner similar to that given for some of the Mucors. He says in a discussion of the potato rot fungus, "All of these facts are now in favor, rather than against distinct mycelial strains (heterothallic forms) except the last, which might indicate a homothallic form, one which contains both antheridia on the same mycelium."

SAPROLEGNIACEAE

Hyphae, long branched, undivided; zoosporangia cylindrical oospores produced from sexual organs, terminal cells are cut off and converted into either

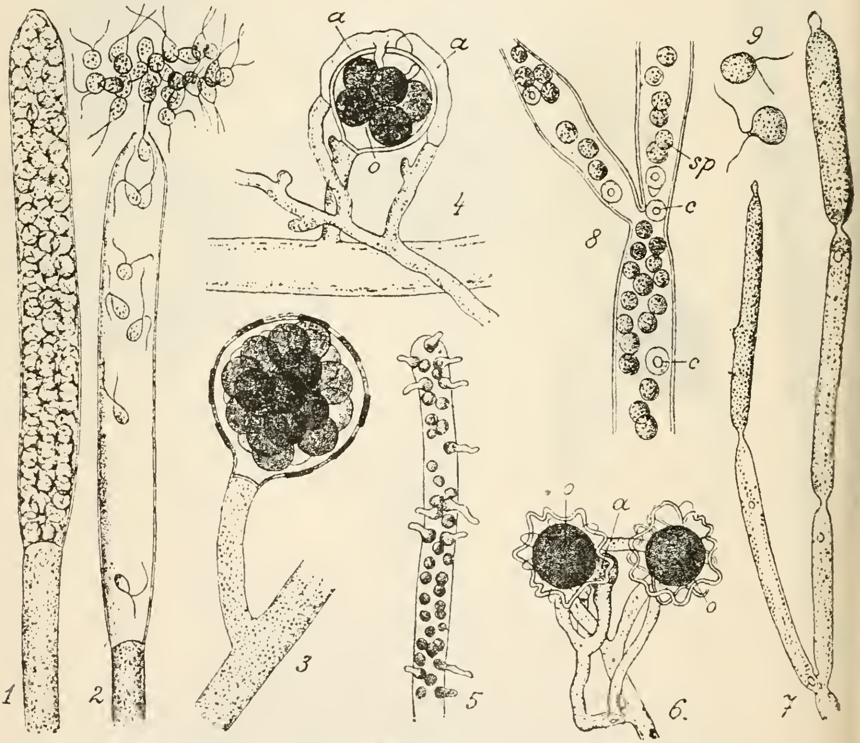

Fig. 52. Saprolegniaceae. Water Mould. 1-3. *Saprolegnia Thureti* x 200. 1. Zoosporangium before the discharge of spores. 2. Same with biciliated spores being discharged. 3. The large spherical body, an oogonium and many oospores. 4. *Dictyuchus clavatus, o*—oogonium, *a*—antheridium. 5. *Aphanes Braunii*, zoosporangium with germinating zoospores. 6. *Aphanomyces stellatus*: *o*—oogonium and *a*—antheridium x 390. 7.-9. *Leptomitus lacteus*. 7. Young zoosporangium x 200. 8. Part of older zoosporangium with zoospores (*sp*) and cellulose grains (*c*) x 300. 9. Zoospores x 430. Fig. 1-3 after Thuret. 4-6 after DeBary. 7-9 after Pringsheim.

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* Rep. Con. Agrl. Exp. Sta. 1905: 304.

oogonia or antheridia. The oogonia may give rise to one or many oospheres or egg cells. The antheridia are tubular and spring from the hyphae below the oogonia. They apply themselves to the oogonia and send out fertilization tubes to the egg cells. The latter then develop into oospores. The asexual method occurs as follows: An examination of the young threads of Saprolegnia will show long filaments which in places are filled with granular protoplasm. Some of these threads are separated from the rest of thread by a cell-wall. Soon the protoplasm arranges itself into polygonal areas. When mature the sporangium breaks and the zoospores are discharged into the water. When emptied a new sporangium is formed by the filament growing up into the old one, or in some cases a branch buds out below the oogonium.

Recent investigations indicate that the egg cell contains numerous nuclei, but as a general thing they are all degenerate but one. The antheridia also contain many nuclei. According to the investigations of some, one male nucleus enters the egg cell and fuses with its nucleus.

Trow,[*] Davis,[†] and Kauffman[‡] have thrown light upon the development of the reproductive body.

Saprolegnia. Nees von Esenbeck. Water mould

Delicate branching hyphae, zoosporangia open from a terminal pore, zoospores pear-shaped with 2 terminal cilia. About 11 species common on decaying objects in water.

Saprolegnia monoica (Pringsheim) De Bary

Zoosporangia cylindrical; antheridia usually in close proximity to the oogonia frequently originating from the same branch; oogonia from short lateral branches; oospore spherical 16 to 22 μ in diameter, germ tube formed in germination.

Distribution. Widely distributed in North America and Europe.

Pathogenic properties. Occurs on dead insects thrown into the water, parasitic on living fish and crayfish. Frequently troublesome in aquaria. The *S. Thureti, DeBary* and *Achlya prolifera* are found on sick fish and crayfish. Hoffmann in 1867 stated that fish in aquaria died under the influence of *Mucor mucedo* and *Saprolegnia.*

It is doubtful, however whether the Mucor produced death.

BASIDIOMYCETES

Conidiophores arise from a many-celled, well developed mycelium, hyphae either separate or forming masses; texture soft, powdery or leathery; the spores various, in the most common type, the basidiospore is borne on special structures known as basidia, from which arise little bodies called sterigmata into which some of the protoplasm of the basidium passes. In one group the mycelium consists of septate, branched threads, at maturity nearly disappearing because of gelatinization; mycelium gives rise to chlamydospores formed endogenously; reproduction sexual and asexual, usually the latter; comprises the sub-classes, Hemibasidii and the Eubasidii.

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[*] Annals of Botany. 18:541.
[†] Bot. Gaz. 35:233.
[‡] Ann. of Bot. 22:361.

Hemibasidii

Mycelium, local or wide-spread, hyaline, septate, branched, becoming compact and giving rise to endogenous spores; the chlamydospores; color varies, in germination the spores produce a promycelium of terminal or lateral sporidia. These may propagate by budding like the yeast plant. The families are *Ustilaginaceae* and *Tilletiaceae*.

HEMIBASIDIALES

This includes two families mentioned in the Hemibasidii.

USTILAGINACEAE, Schröt

Usually parasitic fungi in the tissues of living plants; sori usually exposed, forming dusty masses; spores germinate by means of the septate promycelium which gives rise to terminal or lateral sporidia. In some cases, these multiply like the yeast plant, or else produce infection threads. The order contains about 300 species, with the following genera in North America: *Ustilago, Sphacelotheca, Melanopsichium, Cintractia, Schizonella, Mykosyrinx, Sorosporium, Thecaphora, Tolyposporium, Tolyposporella, Testicularia.* Many plants of the order are destructive parasites occurring upon economic plants like millet, timothy, pink, etc., and one species, the *Ustilago esculenta* on *Zizania latifolia* is edible, being used by the Japanese for food.

Ustilago, Pers. Smuts

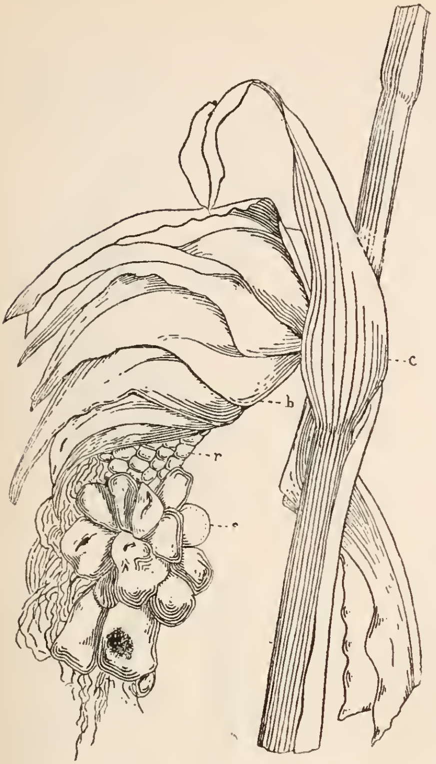
Mycelium septate, branched, gelatinous, sori on various parts of the host, at maturity dusty, usually dark colored; spores single produced in the fertile threads of the mycelium, the latter entirely disappearing at maturity; promycelium septate, sporidia terminal or lateral, producing infection threads; secondary spores formed in the manner of yeast in nutrient solutions. The largest genus of smuts. About 250 or 260 species. Many of them are destructive parasites on cultivated and wild plants.

The *Ustilago minima* occurs upon the porcupine grass, (*Stipa spartea*), and the *Ustilago bromivora* upon the brome grass.

Ustilago Zeae. (Beck). Ung. Corn Smut

Sori in the female or staminate inflorescence, leaves and nodes usually forming irregular swellings of variable size; at first covered by a membrane consisting of the gelatinized threads and tissues of the plant; soon rupturing, which exposes the blackish or brownish spores; spores sub-globose or spherical or irregular; echinulate 8-11 μ or sometimes 15 μ long; spores germinate readily under favorable conditions; spore consists of an outer wall, which is spiny, and an inner more delicate, the endospore; the germ tube or promycelium as it is called, normally bears lateral bodies, the sporidia, but under more favorable conditions of food these may branch and bear secondary conidia. If the nutrient material is not exhausted this process of budding may be continued for a long time. These spores may propagate in a decoction of manure. It will then be seen that these budding conidia may be a center of infection.

The conidia as well as the secondary conidia are blown about by the wind and under proper conditions cause the infection of the corn plant. Several years ago Mr. F. C. Stewart made some extended studies of the germination of corn smut in which it was shown that the thermal death point of smut



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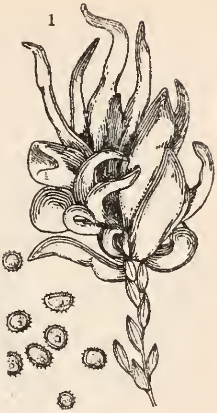

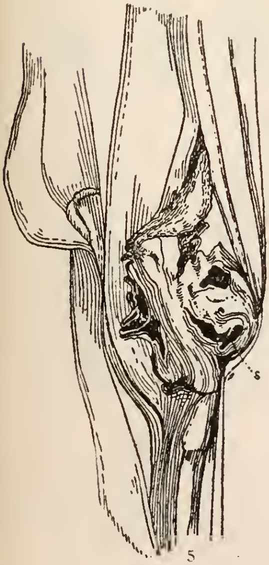

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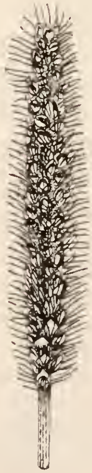

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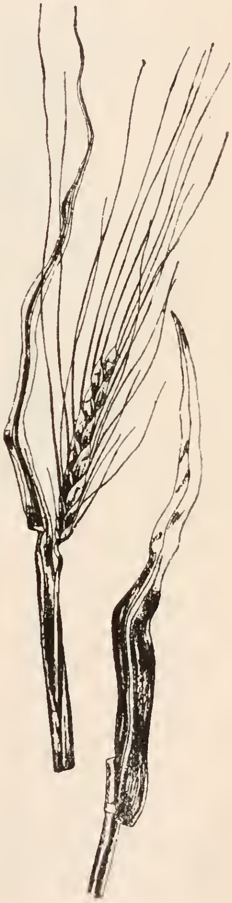

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Fig. 53. Maize smut (*Ustilago zeae*). Ear affected. c. Bracts. e. Smut boils. r. Kernels. 1. In staminate flowers. Fig. 54. Smut boil making its appearance at the nodes. (C. M. King). 2. Foxtail Smut (*U. neglecta*). 3. Covered Smut of Barley (*U. Hordei*).

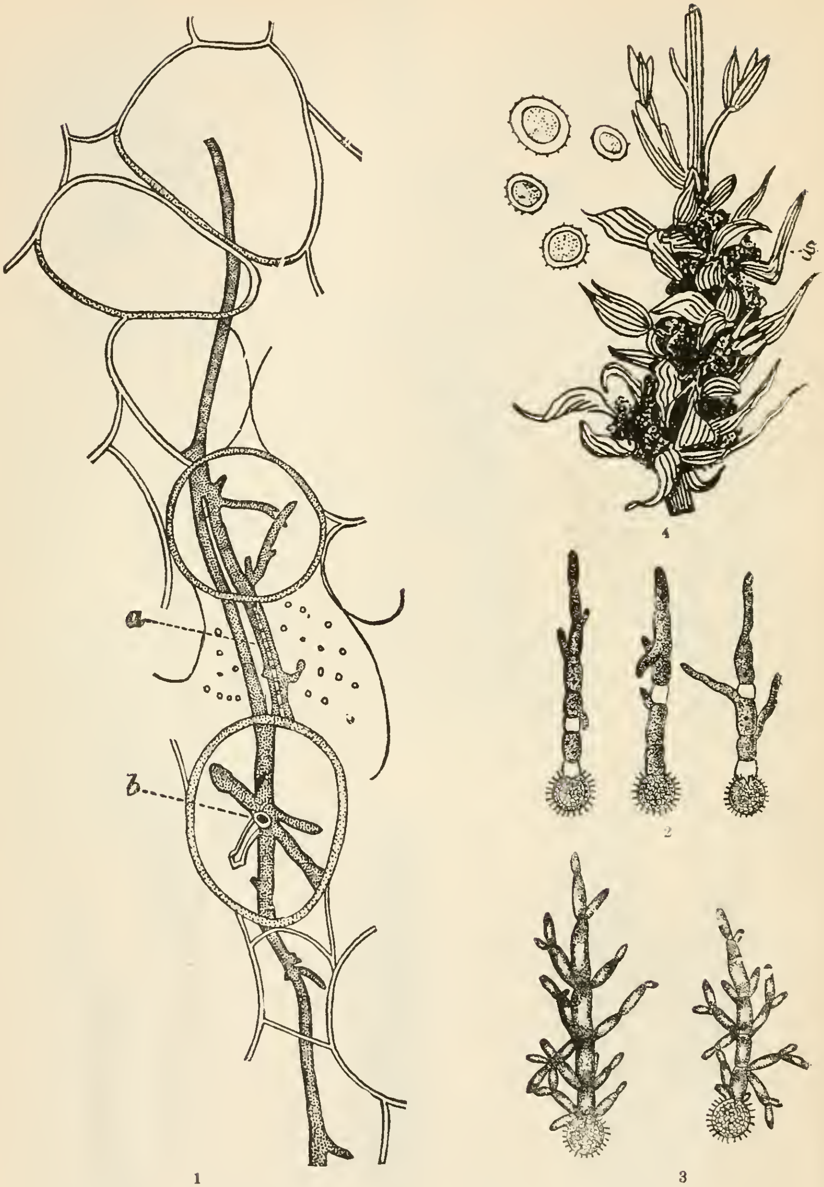


Fig. 55. 1. Maize Smut (*Ustilago zeae*). Cells showing thread of mycelium passing from cell to cell; (*a*) thread shows through; (*b*) section of cut sheath and thread. 2. Corn Smut, Spores in process of germination; each spore is sending out a tube with small lateral bodies. 3. The same, spores germinating in nutrient solution sprouting like yeast. From U. S. Dept. Agr. 4. Kernel Smut of Sorghum (*Sphacelotheca Sorghi*) on Sorghum.

spores is 15 min. 105°-106° C. in dry oven, and 52° C. when immersed in water; and that corn is unable to come through an inch of soil after 15 minutes treatment with water at 70.5° C., and in dry oven at 78° C. Brefeld found that smut spores produced an abundance of secondary conidia when they were germinated in sugar solution, but with us this has never been a very satisfactory method of propagating them as the cultures soon became infected with bacteria which materially check the progress of the germination of spores.

Distribution and Hosts: Corn smut is found from the Atlantic to the Pacific wherever corn is cultivated, also in other parts of the world. In addition to occurring upon corn, it is found upon teosinte.

Poisonous properties. It has been held by many that corn smut is injurious to cattle. This has been a common belief in some quarters. In some kinds of smut a small amount of ergotin is found. Kedsie reports the following composition: Moisture, 8.30 per cent; albuminoids, 13.06 per cent; carbohydrates, 25.60 per cent; cellulose, 24.69 per cent; sugar, 4 per cent; fat, 1.35 per cent; ash, much sand, 25.5 per cent. Professor Kedsie was unable to find any poisonous alkaloids. In 1868, the United States department of agriculture employed Professor Gamgee to ascertain the cause of the cornstalk disease Professor Gamgee records his experiences as follows and concludes that smut is not injurious:

> One cow was fed thrice daily one and one-half pounds of cornmeal and three ounces of smut, mixed with as much cut hay as she would eat. The second had the same allowance, but wet. The amount of smut given in each case was increased to six ounces. The cow fed on dry food lost flesh. Eight days later the dose of smut was increased to twelve ounces three times a day. The cow on the wet food gained in condition, the other one lost. In three weeks the two cows consumed the forty-two pounds of smut. They had a voracious appetite the whole time, and the only indication of a peculiar diet was a very black color of the excrement and the loss of flesh by one animal, although liberally fed on nutritious diet, which, however, was given in a dry state. It is evident that smut is not a very active poison in combination with wholesome food, and especially if the animal is allowed moist food and plenty of water to drink.

Prof. W. A. Henry, in his work on "Feeds and Feeding" speaking of work done by the Bureau of Animal Industry, Clinton D. Smith and Gamgee, says:

> In experiments by the Bureau of Animal Industry, U. S. Department of Agriculture, Washington, corn smut was fed to heifers without ill effects. With all the trials but one ending without disaster, it seems reasonable to conclude that corn smut is at least not a virulent poison, if, indeed, it is one in any sense of the word. It is probable that in the Wisconsin cases, where one cow died and the other was indisposed, the animals suffered because of eating too much highly nitrogenous material rather than anything poisonous. Worse results might have followed the feeding of the same volume of corn meal or cotton seed meal. It would seem that there is little or no danger from corn smut unless cattle consume a large quantity. This is possible where they are allowed to roam through stock fields and gather what they will. There may be cases where animals seek out the smut and eat inordinately of it.

A few years ago Prof. Smith of the Michigan Agricultural College gave the results of some experiments with corn smut. Varying amounts of smut were fed to three grade Shorthorn cows and one grade Jersey. Two of the cows were started with two ounces a day and increased to eleven pounds. Two others were started with two ounces and increased to a pound. The test lasted forty-nine days. They appeared to relish the smut. It produced no signs of abortion in pregnant cows, the milk yield was normal. Prof. Smith concludes that the smut in corn fields is not likely to prove injurious.

Beal states that under certain conditions smut is likely to be injurious to

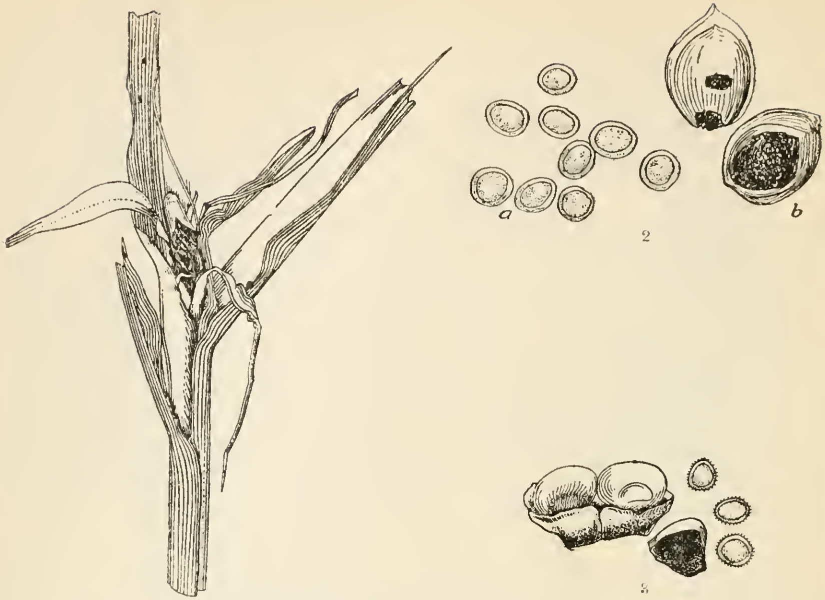


Fig. 55a. 1. Sprouting Grass Smut (*Ustilago panici-miliacei*) showing large swelling in upper part of plant. C. M. King. 2. Millet smut (*Ustilago Crameri*). *a*, spores; *b*, glumes of millet grains filled with a powdery mass of spores. C. M. King. 3. Kernel of smut corn (*Ustilago Fischeri*) on maize. Spores at right. Below a sectional view of an affected kernel. Pammel and King.

cattle. The experiments made by Moore also indicate, as do those of Smith, that smut is not injurious.

Beginning on the morning of January 17, 1894, and continuing until noon of February 2 (sixteen and one-half days), the heifers were fed morning and evening from two to three quarts of a mixture of equal parts by weight of cut hay and a mixture of corn meal, middlings and wheat bran, and sixteen quarts of smut. No injurious affects were observed by Moore. It seems reasonable to conclude from these experiments that under proper conditions corn smut is not injurious. In our experience no cases have ever been reported to us where cattle were supposed to have died from eating corn smut.

Professors Veranus A. Moore and Theobald Smith after making an exhaustive investigation of the so-called corn stalk disease, came to the conclusion that "corn smut is probably not very poisonous, but when fed in considerable quantity no doubt produces injurious symptoms." Miquel in an old work on poisonous plants published in 1838 in Dutch regarded the smuts as poisonous.

Dr. Peters of the University of Nebraska, makes the following comments on the subject of corn smut:

> At a Farmers' Institute at David City a gentleman stated that he had often heard his neighbors say, and he had also read the same in agricultural papers, that cornstalk disease was caused by corn smut. He had the opportunity to make the test for himself. He was compelled to clear the farm he rented of the smut. His son gathered the smutty stalks into a yard where two cows ate considerable of the smutty leaves. No bad results followed, as witnessed by the gentleman himself and the owner of the place.

Mr. J. J. Jolliffe in the Drovers' Journal of February 7, 1902, says:

> I have never had any bad results from smut. I have watched the stock eat ears that seemed 75 percent smut, and they devoured them apparently with as much avidity as sound ears, never affecting the health or appetite in the least.
>
> We have seen cattle die in fields where there was no smut whatever on the stalks and also in some fields that had previously been cleaned as good as one could clean them from this smut; the cattle died in spite of this precaution. Often the owner of the neighboring fields, in which large quantities of smut were found, did not believe this theory and allowed his cattle to run in the stalks promiscuously without suffering any losses.

At the Illinois Experiment Station about sixty pounds of corn smut were fed to a grade Jersey steer, with grain and hay as follows:

> From December 13, 1889, to January 2, 1890, 120 pounds of grain, 105 pounds of hay, 20 pounds of smut, and 371 pounds of water were given. From January 2 to January 24, 1890, 176 pounds of grain, 135 pounds of hay, and 39 pounds of smut were fed and 366 pounds of water given. When the experiment was begun, December 13, 1889, the steer weighed 560 pounds. January 2, 1890, he weighed 551 pounds, and January 24, 555 pounds. No evidence of disease was discovered.

Dr. Kilborne records two experiments to test the effects of corn smut. In the first case the smut used came from a field in which several animals had died within five days after they had been turned into it. Three two-year-old steers were fed exclusively on smut-laden stalks and free smut mixed with a small quantity of a mixture of corn meal and wheat bran, for seven days without ill effects. He concludes: "It is safe to say that these animals consumed a much greater quantity of smut than the animals which died in the fields." In the second case, two heifers were fed in addition to corn and hay, sixteen quarts of smut morning and evening for sixteen and a half days. This feeding continued for several months. The animals appeared healthy at the termination of the experiment.

Dr. N. S. Mayo records the experience of a farmer near Manhattan, who gathered the smut from the field and placed it within an enclosure. The cattle broke into the enclosure one night where the smutty corn was thrown and ate all they wished, but no injurious effects were observed.

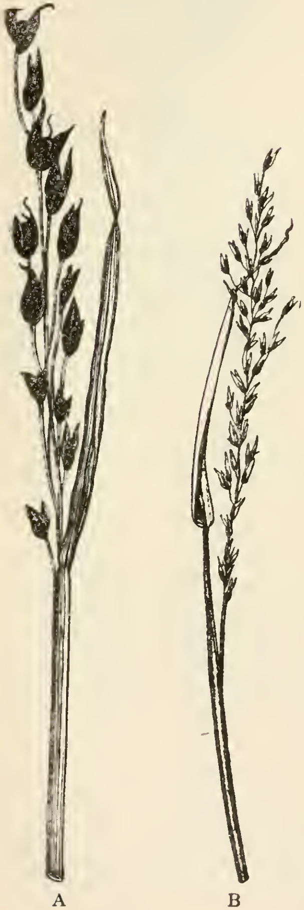
Ustilago avenae (Pers.) Jens. Oat Smut

Sori found in the spikelets forming a dusty olive brown mass, usually destroying the whole of the inflorescence or only a part; the spore mass at first covered by a membrane which later breaks, thus allowing for the scattering of the spores; spores olive brown, lighter colored on one side, spherical to subspherical or somewhat angular, minutely roughened, 6-9 μ in length. Spores germinate readily in water; infection takes place at the time of germination of the oats.

Distribution and hosts. Found wherever oats (*Avena sativa*) is cultivated also on wild oats, (*A. fatua*).

Poisonous properties. Probably not any more injurious than corn smut. When present in large quantities it may produce a sore throat, because of irritation. This fact is mentioned by White. The following note from Dr. White refers to another species found upon grass:

> The inflammation affects almost exclusively the face and genitals. It begins upon the former with a violent itching in about twenty-four hours after contact with the reeds, which is followed by a uniform redness, especially marked about the orifices, and swelling of the eyelids. The appearance of the patient strongly resembles that of erysipelas. Later small vesicles develop, terminating in persistent excoriations.
>
> Upon the male genitals it begins also with itching, followed by general swelling, with intense redness of the scrotum, and later by vesicles filled with a yellow serum, terminating



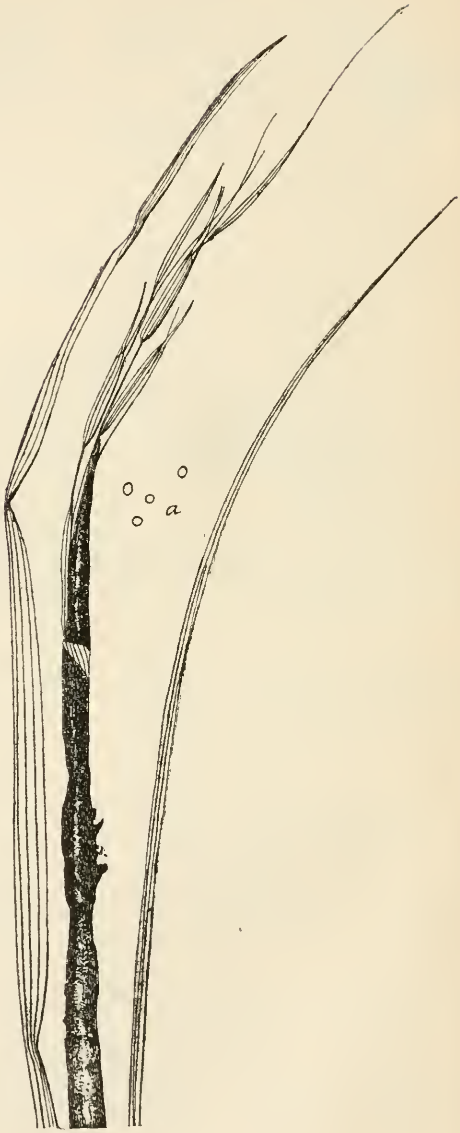


Fig. 56. A. Oat Smut (*Ustilago avenae*). From U. S. Dept. of Agrl. B. Tall Meadow Oat Smut (*Ustilago perennans*).

Fig. 56a. Porcupine Grass Smut (*Ustilago hypodites*) affecting parts of inflorescence and culm; *a*, spores, said by Dr. White to be an irritant. C. M. King.

in persistent and very painful erosions. The penis is sometimes affected, producing an inflammatory phimosis.

Delicate skins are most easily affected, and a moist condition favors the action of the parasite. Similar effects were produced upon the skin of the rabbit, by applying to it after being shaved some of the fungus removed from the reeds.

"After reading the above, I wrote to Prof. W. G. Farlow of Cambridge, our authority in crytogamic botany, with regard to the occurrence of this species in America, and received the following reply:"

Your information about the poisonous character of *Ustilago hypodites* is something quite new to me. I do not know of any reference to the subject in botanical books. The spores of *Ustilagineae* are known to be at times irritants when they reach the air-passages, but they are not poisonous to handle. *U. hypodites*, a species whose characters are not very well marked, I may say, has been found in two places in this country. I found it at Wood's Holl, Mass., on *Phragmites* (reed). It was found by Curtis in North Carolina on *Arundinaria*, the cane, and what is probably the same species occurs in Iowa on a species of Stipa. The fungus may be much more common in this country than is now supposed, as few persons have collected fungi of this order.

Ustilago maydis, the corn-smut, grows upon our maize, and *U. segetum* attacks several of our grains, wheat, oats, barley, and our grasses; but I have never heard of their producing any irritative action upon the skin."

Ustilago nuda (Jens.) Kell. & Sw. Barley Smut

Mycelium found in spikelets forming a dusty olive brown spore mass, protected by a thin membrane which soon becomes ruptured and allows for the dispersal of the spores. Spores lighter colored on one side, minutely roughened, spherical, subspherical or elongated; 5-9 μ in length. Infection probably takes place at the time of flowering of barley.

Poisonous properties. Like the preceding. *Ustilago Hordei*, found upon barley, differs from the species described because of an adhering purple black spore mass covered permanently by the lower parts of the glumes.

Distribution and hosts. Found wherever barley is cultivated in Europe and North America.

Ustilago Tritici (Pers.) Jens. Wheat Smut

Spore masses found in the spikelets of the inflorescence forming black or olive brown mass; usually destroying the entire floral parts, and later spores are scattered by the wind; spores usually spherical or nearly spherical or somewhat elongated, minutely roughened, 5-9 μ in length.

Distribution and hosts. Common upon wheat wherever cultivated in Europe, Australia and North America and South America.

Poisonous properties. Probably injurious like the preceding smuts.

Ustilago Panici-glauci (Wallr.) Wint.

Sori in spikelets infecting all the spikes; spore masses enclosed by glumes, with a rather firm membrane; soon ruptured, permitting the scattering of the spores; spores dark brown, usually spherical or ovoid, occasionally elongated, rather prominently echinulate, 10-14 μ in length.

Distribution. Widely distributed in Europe and North America. One of the most common smuts wherever foxtail grows.

Poisonous properties. It is supposed by some farmers to cause abortion but there is nothing to support this view. According to Professor Power it contains a small amount of ergotin. Possibly injurious like the other species of smut.

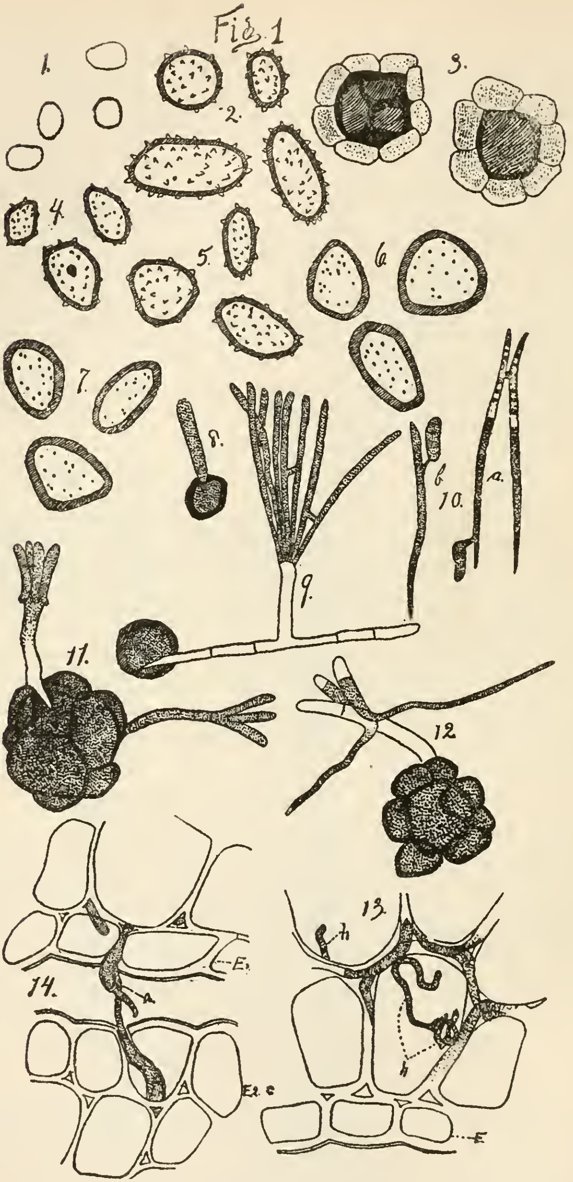


Fig. 57. Smut spores of various kinds. 1. Tall meadow oat smut (*Ustilago perennans*). 2. Timothy smut (*U. striaeformis*). 3. Rye smut (Urocystis occulta). 4. Cheat smut (*Ustilago bromivora*). 5. Foxtail smut (*U. neglecta*). 6. Millet smut (*U. panici miliacei*). 7. Sandbur smut (*U. Cesatii*). 8, 9. *Tilletia* germinating. 10. Secondary spores from conidia. 11, 12. *Urocystis* spores germinating. 13, 14. Mycelium of same. *h*. Suckers or haustoria. *h*. Hyphae passing from one leaf to another. 8-14 after Wolff.

Mr. W. A. Kelty informs me that the smartweed smut (*Ustilago utriculosa*) often produces severe irritation of the hands when corn is husked.

TILLETIACEAE, Schröt

Mycelium becoming gelatinized in the tissues; the promycelium gives rise to the terminal cluster of elongated sporidia which fuse or do not fuse in pairs, producing secondary sporidia which may be alike or unlike, or the sporidia germinate directly into infection threads. About 150 species, of which Tilletia is the most important genus; aside from the two species described below one species, *T. secalis* is found upon rye, *T. hordei* upon barley,, etc., *Neovossia Iowensis* on *Phragmites communis, Urocystis occulta* on rye, *Urocystis agropyri* upon quack grass, and *Entyloma ranunculi* upon anemone.

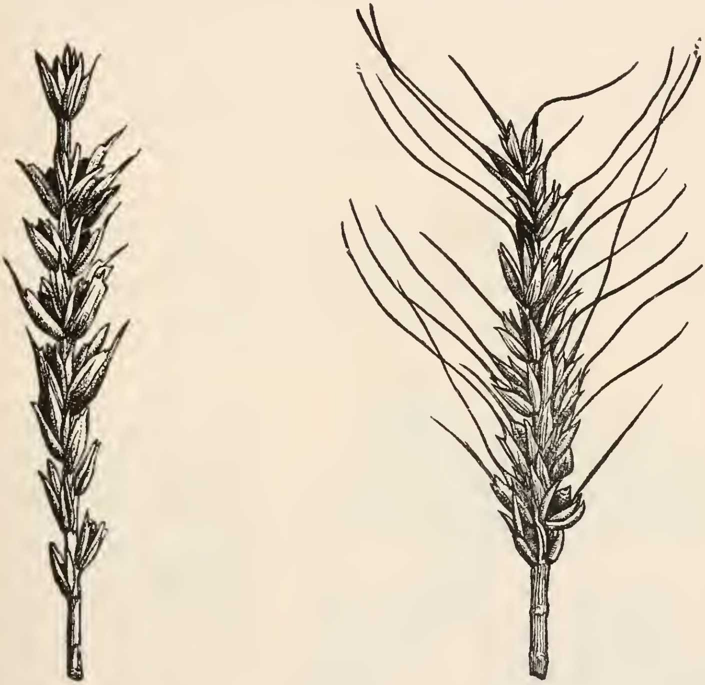


Fig. 58. Wheat Bunt (*Tilletia foetens*). At the left, a beardless variety with bunt kernels. At the right, a bearded variety with bunt kernels. From U. S. Dept. Agrl.

Tilletia, Tul. Bunt

Sori in various parts of the plant, usually in the ovaries, forming a dusty spore mass; spores 1-celled, formed singly in the ends of the mycelial threads, promycelium of germinating spore short with a terminal cluster of elongated sporidia. 53 species are reported for the genus.

Tilletia foetens (B. & C.) Trel. Stinking Smut or Bunt

Sori in the ovaries, wheat glumes more or less spreading; spores light to dark brown, oblong or sub-spherical, or spherical or sometimes irregular, 16-20 μ in diameter; bad odor just before maturity and retaining the odor even in stored grain.

Distribution and hosts. Common in eastern North America, also in Canada and Manitoba.

Poisonous properties. It produces a bad odor when it occurs in flour and also gives the same a dark color and makes it unsalable.

Tilletia Tritici (Bjerk.) Wint. Wheat Bunt

Sori in the ovaries of wheat ovate or oblong, glumes spreading; spores chiefly spherical or sub-spherical; 16-22 μ in diameter, light to dark brown with winged reticulations. Infection of this and the preceding smut occurs at the time of germination of wheat, hence all of the stalks growing from the single wheat kernel become infected, mycelium growing upward with the growth of the plant.

Distribution and hosts. Common upon wheat wherever cultivated. Reported as destructive and abundant in Michigan, Montana, and Kansas.

Poisonous properties. Same as in the preceding species.

Eubasidii

Conidiophores with true basidia; reproduction generally asexual, sexual in some cases through the fusion of nuclei; spores cut off from the ends of the threads or borne on little sterigmata. The group is divided into two divisions according to the form of the basidia: *Protobasidiomycetes*, the rusts and gelatinous fungi; *Autobasidiomycetes*, toad stools, mushrooms, and puff balls.

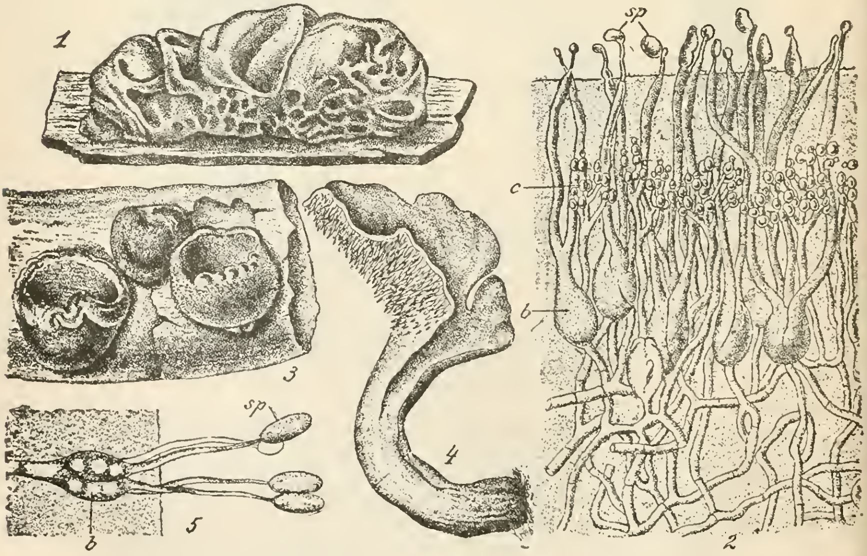


Fig. 59. The Gelatinous Fungi. *Tremellineae*. 1. *Tremella lutescens* on wood. 2. Cross section through hymenium, *b*—Basidia, *c*—Conidia, *sp*—Basidiospores, x 450. 3. *Exidia, truncata*. 4. *Tremellodon gelatinosum*. 5. Basidia of the same x 560. 1-3 after Brefeld. 4-5 after Mueller.

PROTOBASIDIOMYCETES

Parasitic or saprophytic plants; basidia with longitudinal or cross septa; mycelium septate, branched, either in the interior of the plant as parasites or ramifying the substratum; spores various. The following types occur: spermatia, aecidiospores, uredospores, teleutospores, and sporidia; the spermatia are always accompanied by other spores, generally with the aecidiospores; the aecidiospores are 1-celled and occur in cups; the uredospores are 1-celled, occur in a powdery mass, and germinate immediately; teleutospores arise from the same mycelium that produces the uredospores, one or more cells, on germination they produce a promycelium that bears the sporidia. This group contains the following families: *Endophyllaceae* with a fungus parasitic on the leaves of spurge, stonecrop and house-leek; *Melampsoraceae* including several important economic fungi; *Pucciniaceae* containing a large number of genera; the *Auriculariaceae*, gelatinous fungi common on decaying wood.

MELAMPSORACEAE

Teleutosori forming incrustations on the surface of leaves; uredosori powdery; aecidia without pseudoperidium (Caeoma) or with well developed

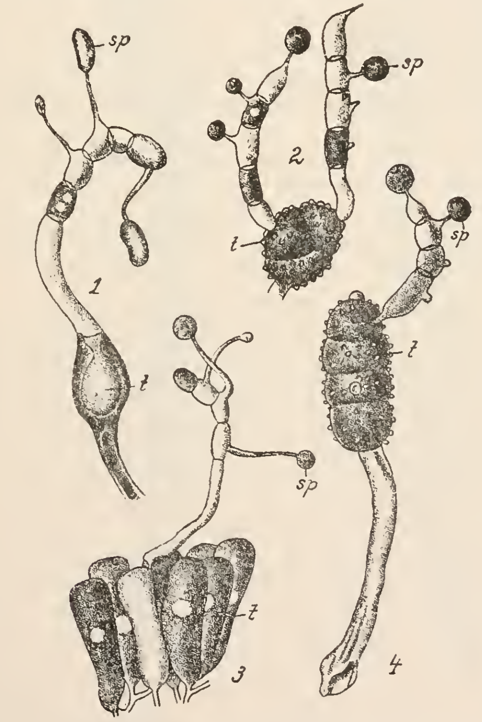


Fig. 60. *Uredineae.* Teleutospores of different genera germinating. By germination originate the promycelia which divide into cells, each of which produces a conidium. 1. *Uromyces Fabae* x 460. 2. *Triphragmium Ulmariae* x 370. 3. *Melampsora betulina* x 370. 4. *Phragmidium Rubi* x 370. *t*—Teleutospore; *sp*—Conidium. After Tulasne.

pseudoperidium; uredospores 1-celled occurring singly or in groups with or without pseudoperidium; paraphyses present, teleutospores 1-4-celled, closely or loosely united in the plant underneath the epidermis; *Calyptospora Goeppertiana* occurs upon the huckleberry and blueberry, (*Vaccinium*) connected with the *Aecidium columnare,* a very troublesome parasite upon Abies. The *Melampsora populina* occurs on the cotton-wood, the cotton-wood rust forming red sori on the leaf of the cotton-wood, with waxy incrustations. The other troublesome parasite, the *Chrysomyxa Rhododendri* occurs upon *Rhododendrum.* There are about 100 species in the family.

Coleosporium. Lev.

Teleutosori forming flat waxy masses in the leaf; teleutospores composed of several vertical cells enclosed in a thick transparent membrane; each cell germinates by a single undivided promycelium which produces at the end a single sporidium; uredosorus reddish or orange, powdery; spores spherical or sub-spherical, ovate, elliptical, oblong or cylindrical, produced in basipetal chains. A small genus of 30 species.

Coleosporium Solidaginis (Schw.) Thüm. Golden Rod Rust

Uredosori rounded, soon pulverulent and scattered, orange spores in short chains, spherical, oblong, or sub-cylindrical spiny, 20-35 x 15-20 μ; the teleutosori at first orange, becoming red, flat often confluent forming waxy crusts; Teleutospores cylindrical or somewhat clavate generally 4-celled 60-70x15x25 μ, occasionally longer.

Distribution and hosts. Found in various Compositae, notably *Solidago canadensis, S. serotina,* etc., *Vernonia noveboracensis* and *Sonchus.* Occurs in both Europe and America.

Poisonous properties. Suspected of being injurious to horses; possibly produces stomatitis. Referred to at length under Golden Rod.

PUCCINIACEAE

Teleutospores with a short or long pedicel; spores single or in groups; spores one or more celled; frequently interspersed with paraphyses; spore mass powdery or gelatinous; sporidia arising either from the promycelium or from a similar sterigma after segmentation of the spore contents; aecidia with or without pseudoperidia; uredospores 1-celled, arising from the conidiophores. Includes the *Gymnosporangium macropus* which produces its aecidium stage on the apple and the teleuto stage on the red cedar, the cedar apple gall with its long gelatinous horn being characteristic; and various aecidia connected with various rusts. Many species have a well marked alternation of generation, an aecidium on one host and the uredo and teleutospores on another host. The *Hemileia vastatrix* produces the coffee leaf disease of Asia, *Phragmidium subcorticum,* the rose rust. This large family contains 1500 species.

Recent investigations on the subject of the fertilization and reproduction in the rusts have been made by Profs. Olive, Blackman, Christman, Holden and Harper, and others. These studies seem to indicate that fertilization occurs, but that this fertilization is not, as was thought by the older writers, to be compared with that which occurs in some of the Ascomycetes. The older view was that the spermogonia were male organs and form a strictly morphological standpoint comparable to the structures of like character found in that group of

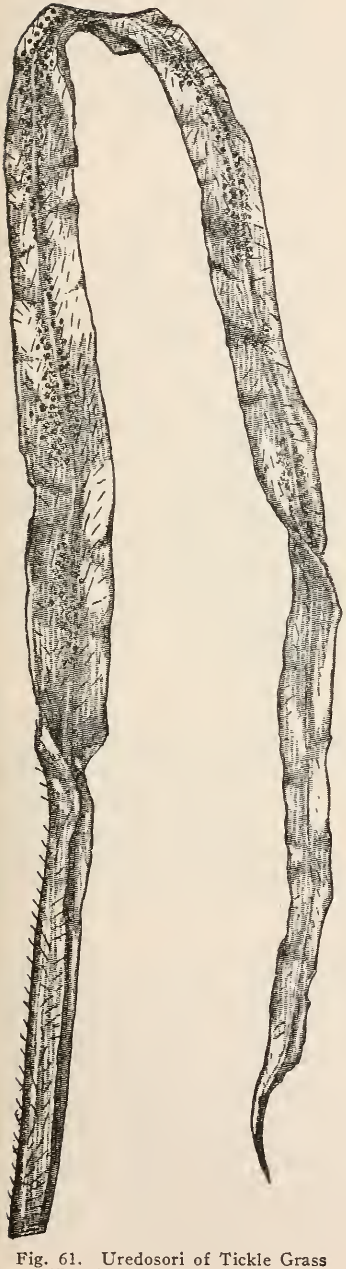


Fig. 61. Uredosori of Tickle Grass Rust. (*Puccinia emaculata*).

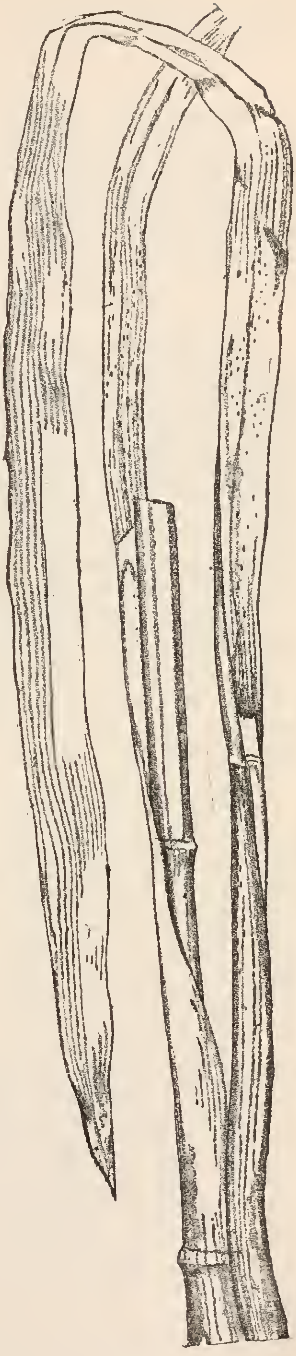


Fig. 61a. Teleutosori of *Puccinia coronata* on leaf of oats. Sheath affected with *Puccinia graminis*.

plants. Clements arranges the rusts with the Ascomycetes. He considers that the apothecium is reduced.**

Puccinia, Pers. Rust

Teleutosori flat, usually powdery masses; teleutospores separate with pedicels, usually consisting of 2 cells, occasionally 1-celled, or sometimes more than 2 cells; the germ pore of the upper cell, at the apex, the lower cell with the germ pore placed laterally below the septum; the promycelium septate with several sporidia. The teleutospores germinate immediately in some species, in others after a period of rest. About 700 species.

Puccinia graminis, Pers. Common Grass Rust

The aecidiospores generally circular, thick swollen with reddish spots surrounding the infected area, yellow below; peridia cylindrical with whitish torn edges; spores subglobose smooth orange yellow, 15-25 μ in diameter; spermogonia on the upper surface consisting of small black dots, uredosori orange red, linear but often confluent, forming long lines, powdery masses; spore elliptical, ovate or pyriform, echinulate, orange yellow 25-38 x 15-20 μ; germ pores 2 above the center on each side; teleutosori persistent; open, generally forming lines on the sheaths, stems and inflorescence; teleutospores fusiform clavate constricted in the middle generally smaller below the apex, thickened, rounded or pointed smooth chestnut brown 15-20 x 35-65 μ; pedicels long and persistent.

The life history of common grass rust is as follows: The common rust produces three stages. One stage occurs in the barberry and is known as the cluster cup fungus. This stage makes its appearance in the northwest some time during the month of June, in the latitude of Ames, a little before the middle of the month. An examination of an affected leaf will show small black specks on the upper surface, surrounded by a yellow spot; this is known as the

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* The Genera of Fungi. 5. 98.

** Christman in his studies (Bot. Gaz. 39:267; Trans. Wis. Acad. Sci. 15:517; Bot. Gaz. 44:18.) of the common rose rust (*Phragmidium speciosum*) finds that the ends of the hyphae produce a terminal sterile cell and a lower fertile one; the fertile cells fuse in pairs with one another, the cell walls breaking down. The nuclei lie side by side and divide, two of the daughter nuclei remaining in the lower part and two passing to the upper part of the dividing cell. Then the upper portion becomes separated by a transverse wall and becomes the first spore mother cell. These fusing cells are approximately equal. Blackman (Ann. Bot. 18:323, See also Ann. Bot. 20:35.) in his studies of another species of the same genus, states that the fertile or female cell contains a larger nucleus and that the male cell is reduced; that the hyphae which gave rise to an aecidium first cut off a sterile cell, and the cell below which at first only contains a single nucleus becomes binucleated because of the passage of the nucleus from an adjoining cell. Successive divisions of the nuclei occur and finally we have a chain of spore mother cells; each having a pair of nuclei.

Dr. Olive (Annals of Bot. 22:331. Bull S. Dak. Agrl. Ex. 81:119) who has made a close careful study of *Triphragmium ulmariae* comes to the conclusion that two fusing gamets as well as their nuclei are approximately equal, and that the two gamets differ somewhat in time of development. "That the apparently normal and regular occurence at the base of certain young aecidia of one to many multinucleated cells, points to the necessity of a broader conception as to the mode of development of the aecidium-cup than that held by either Blackman or Christman. While the part which these multinucleated cells take in the development of the aecidium is as yet somewhat obscure, the evidence appears to point to the conclusion that they are sporophytic structures and that they result from the stimulated growth which followed sexual cell fusions. Should this prove true, it is obvious that the 'fusion cell' does not at once function as a 'basal cell', at the bottom of each spore-row, as maintained by Christman for this type of Rust. Further, the occurrence of occasional instances suggesting 'nuclear migrations,' undoubtedly of a pathological nature, between the multinucleated cells of *Puccinia Cirsii-lanceolati*, throws doubt on the idea as to the normal origin of the binucleated condition in the aecidium-cup by this means."

It may be of interest further to state that Holden and Harper (Trans. Wis. Acad. Sci. 14:63.) have studied a species of Coleosporium and find that the fusion nucleus divides in a manner similar to that of higher plants.

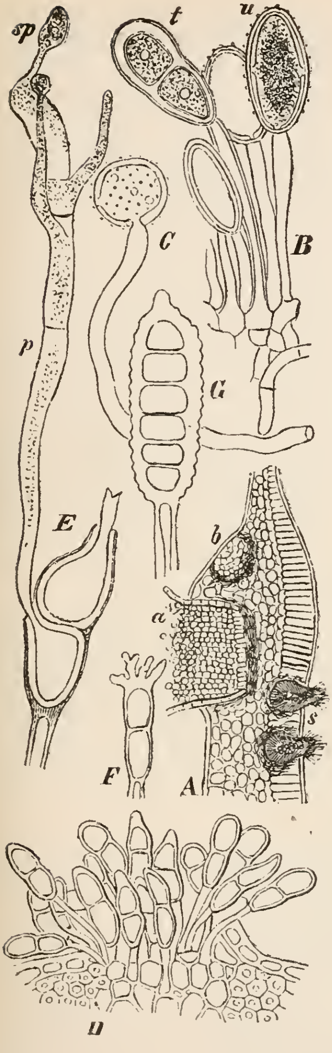


Fig. 62. Some Rusts. *A, B. D. E. Puccinia graminis. A.* Aecidium or Cluster-cup on Barberry; *a* aecidium, *s* spermogonia on upper surface. B. Uredo spores; *u* one-celled, teleutospores two-celled. C. Germination of uredospores showing long tube. D. Connection of stem showing two-celled teleutospores. E. A teleutospore germinating with promycelial tube (*p*) and sporidia (*sp*). F. Two-celled teleutospores of *Puccinia coronata* on oat leaf. G. Teleutospores of *Phragmidium incrassatum.* All much enlarged. A and G after Luerssen. B-D after DeBary. E after Tulasne.

spermogonial stage; the flask-shaped bodies are called spermogonia and contain the spermatia which do not germinate; their function is not known. A sweetish fluid, which attracts insects, is frequently found in connection with these. Directly opposite the flask-shaped bodies are small globular affairs, "cups," (aecidia), slightly irregular on the margins. Owing to their upward growth they rupture the epidermal cells, and finally the lining layer of cells of the cups also breaks, thus exposing a large number of 1-celled spores borne in chains. These spores arise from short stalks contained at the base of these cups; the cluster cup spores are known as aecidiospores and are transported by the wind and other agencies, and have the power to germinate soon after maturity. When the proper host — a grass, such as bent grass, oats or wheat — appears, the germ tube enters by way of the stomata, or the so-called breathing pores. The germ tubes produced by the spore of *Aecidium berberidis* are simple or branched, and in fourteen days usually give rise to the uredo spores, which occur in definite spots called sori. These spots occur in great numbers along the veins of the leaves. Before breaking open, the tissues of the leaf are somewhat paler at those places. The nourishment afforded by the host causes a vigorous mycelium to form, which soon collects in places, pushes the epidermis out, and an orange-colored pustule is formed which is known as the uredosorus.

A section through a diseased sorus shows that an abundance of the vegetative mycelium grows between the cells of the plant, and in some cases haustoria penetrate them. This pustule contains a large number of 1-celled, round or elliptical, spiny, orange colored spores, the uredospores. The spores have two membranes, the outer exospore being provided with wart-like projections, while the inner endospore is provided with several pores through which the germ tube appears. These spores germinate in from three to four hours and can thus start a general infection. These spores, carried by the wind, rain or insects to another part of the same or another plant, germinate, the germ tubes branch and spread over the surface, but the tube cannot enter the host — a grass of some kind, such as wheat, oats or barley — unless it reaches the opening of the stoma, since it cannot bore through the epidermal cells. A single sorus contains hundreds of spores, and as a single plant may contain hundreds of pustules, it can readily be seen that rust must become quite general.

The red rust stage is followed by the black rust stage, known as the teleuto stage. The sori are brownish-black in color, and frequently occupy the same place that the uredo stage did. The spores are dark brown in color, two-celled and smooth, having attached to them a persistent stalk known as the pedicel. The teleutospores do not germinate till the following spring, when each cell produces a germ tube, the promycelium bearing lateral spores, sporidia. These sporidia, when in contact with the barberry leaf, enter by boring their way through the epidermal cells.

The barberry cluster cup fungus, and its connection with common grass rust. It is not absolutely necessary for the common grass rust to have its first stage on the barberry, yet experiment has shown beyond doubt that it does occur on that plant. The theory has been advanced that appearing in one of its stages on the barberry gives the parasite new vigor. It is not improbable that in some places the mycelium or vegetative part of the fungus may be perennial in the tissues of grasses, as it is with many other fungi, probably this is true in southern localities. Beyond question this rust produces spores during the entire year in our southern states, and on the approach of early spring gradually moves northward. It may also be mentioned that in the west this rust certainly does not appear before the cluster cup fungus on the barberry appears. It is usually eight or ten days later, and then appears to a limited extent only. Rust often appears where barberry does not occur within hundreds of miles. This was especially noticeable during the early history of grain culture in the northwest. Rust follows a general infection.

Distribution and hosts. This fungus has been found not only upon wheat but also upon several species of *Bromus, Trisetum* and *Triticum spelta.* Its distribution cannot be given because in most cases the *P. rubigo-vera* included this as well as the *P. glumarum.* It has been intimated above that the uredospores make their appearance on young germinating plants in the fall, but it appears that the uredo spores are not common the following spring. The investigations of the authors quoted here indicate that not in a single case was it possible to produce uredospores in the spring from those of the autumn.

H. L. Bolley, of Fargo, N. D., remarks in regard to several cluster cup fungi which occur on members of the Borage family:

> Several aecidia of unknown life history have been studied with reference to their relations to the red rust of *Puccinia rubigo-vera,* many infection tests being made upon young wheat and oat plants, all with negative results.
>
> In this region *Onosomodium Carolinianum* bears very profusely an aecidium, which, because of its date of appearance, was worthy of suspicion; but tests enough were made to remove this notion.

P. rubigo-vera as well as the common grass rust, is very destructive in England and Australia; but according to Wolf, is not so common in Germany. A few years ago Professor Arthur investigated the subject of wheat rust in Indiana and found that this species was much more destructive to wheat in that state than common grass rust. The same year, 1889, the writer found that this rust was much more common on wheat in Iowa. Carleton says he is confident that the orange-leaf rust (*P. rubigo-vera*) does very little if any damage to the grain in this country; that in all cases of serious damage to the grain by rust the black-stem rust (*P. graminis*) is the real cause. In 1907, the leaf rust was very destructive to spring wheat in Iowa.

Puccinia glumarum, Schmidt

Aecidium unknown; the uredosori occur along the veins. The diseased leaf is frequently of irregular contour, color orange yellow, spores spherical, or short, elliptical, spiny. Teleutosori, grayish, covered by the epidermis on the stalks and leaves, less frequently on the flowers. Sori divided into chambers,

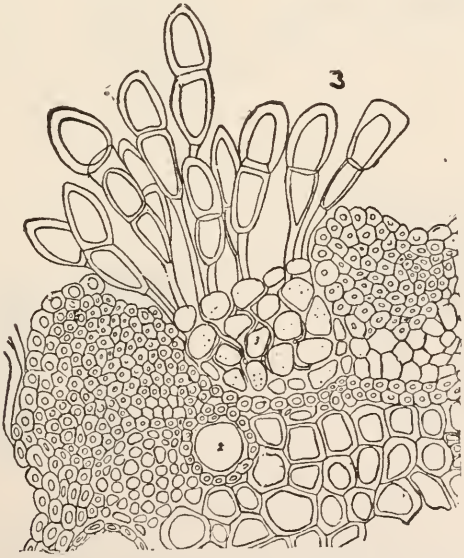


Fig. 63. Covered Rust of Wheat (*Puccinia rubigo-vera*) from wild Barley, perhaps the same as *P. glumarum.*

surrounded by paraphyses. Spores with short pedicels, mostly club-shaped, unsymmetrical; apex somewhat truncate, or with one or two projections.

Distribution. Common in Europe and probably also in this country; has usually been referred to as *Puccinia rubigo-vera.* In European mycological works, the aecidium of this fungus is said to be very common on common speedwell (*Lithospermum arvense*), *Echium vulgare*, and *Anchusa officinalis.*

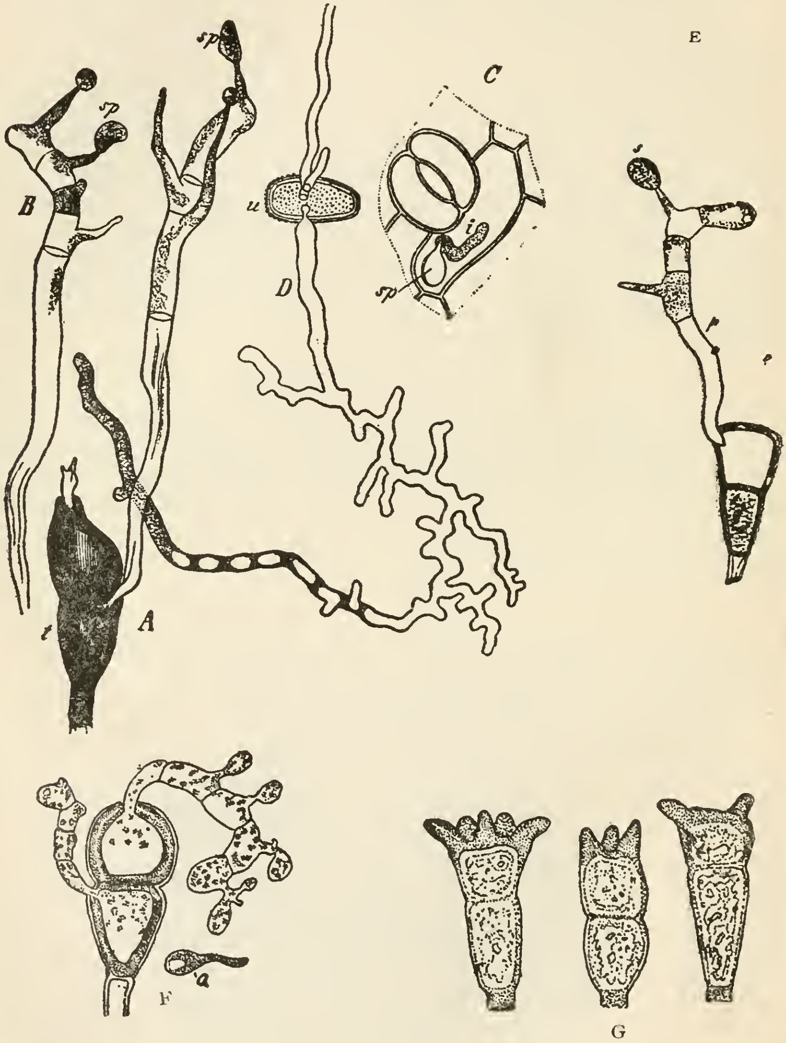


Fig. 64. Forms of rust on cereals. A. Common wheat rust, *Puccinia graminis* on sheath of wheat, winter spores germinating. B. The same, sporidia *sp.* *C.* Epidermis under surface of leaf with sporidium. *sp.* and germ tube. *i.* penetrating the epidermis. *D.* Uredospore germinating after being in water 14 hours in *E. Puccinia rubigo-vera* germinating. *F. Puccinia graminis.* Both cells have germinated. *a,* sporidium germinating, magnified x 600. *G.* Crowned rust (*P. coronata*) from oat leaf. G after Bolley; the remainder, DeBary.

Common speedwell is a very common weed in St. Louis and other parts of Missouri and southern Illinois, but so far as known, the aecidium has not been found on these weeds.

Puccinia dispersa. Eriks, & Hen.

This species of rust is apparently very common in Europe. There are three different stages. The aecidium stage produces circular or elongated, somewhat swollen, spots on the leaves, petioles and stem of several members of the borage family. The spores are between 20 to 30 μ or 20 to 30 μ x 19 to 22 μ in diameter. The teleuto spores long remain covered by the epidermis. The sori are chambered, surrounded by numerous brown paraphyses; spores are mostly club-shaped, unsymmetrical and 40 to 50 μ long.

Puccinia coronata. Cda. Crowned Rust

The aecidium produces round or elongated spots with elongated, conspicuous aecidia; the spores from 18 to 25 μ x 14 to 19 μ; the uredosori are long, confluent, mostly on the upper surface of the leaf; they are orange-colored, and are soon exposed, each pustule containing a large number of 1-celled subglobose, roughened spores which are spherical or short-elliptical; the uredospores are yellow, 20-32 μ in diameter by 28-32 x 20-24 μ. The teleutospores remain covered by the epidermis, and in this respect they resemble the covered rust of wheat (*Puccinia glumarum*). They usually occur on both sides of the leaf. The spores are short-stalked, cuneate and more or less truncate above, crowned with several projecting horns.

Distribution and hosts. Common wherever oats is cultivated and in several of its forms it occurs upon cultivated grasses. This is a well known destructive rust of oats and several other grasses and has received considerable attention from early mycologists. Klebahn has recently described this rust under several distinct forms. The *P. coronata dactylidis* in a narrow sense includes the rust upon *Dactylis glomerata* or orchard grass, *Festuca sylvatica* with aecidia on *Rhamnus frangula* and *P. coronifera.*

Ericksson and Henning distribute these forms into *P. coronata* I, and *P. coronata* II. Historically this rust is of considerable importance, since Gmelin was familiar with this disease in 1791, and described it as *Aecidium Rhamni* on *Rhamnus.* The aecidium stage occurs on species of buckthorn (*Rhamnus*) especially (*R. cathartica* and *R. Frangula*). In Iowa an aecidium is frequently found on a native buckthorn (*R. lanceolata*), but its connection with this host has not been studied. The aecidium attacks not only the leaves, but occurs on mid-vein, petiole, pedicels and flowers. As a result of the attacks, distorted leaves and flowers are produced.

Puccinia sorghi. Schw. Maize Rust

Uredo and teleutosori upon the leaves and bracts; the former small, light brown sori, soon rupturing the epidermis; teleutosori dark brown; the uredospores are 1-celled, round or more elongated and spiny; the stalk is detached; the spores measure 23-38 x 20-26 ; teleutosori are elongated dark brown or black being broadly elliptical and 2-celled, 30-52 x 16-24 ; the apex may be thickened and somewhat pointed. These spores preserve their vitality for some time; but are dormant through the winter. In the spring each cell may germinate by producing a tube, known as the promycelium, which bears lateral bodies known as sporidia. Acording to Dr. J. C. Arthur, it is undoubtedly connected with an aecidium on *Oxalis corniculata.*

Distribution and hosts. Common wherever corn is cultivated and according or Carelton, also upon teosinte.

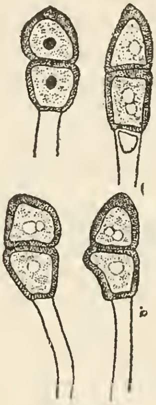


Fig. 66. Corn rust (*Puccinia Sorghi*) on corn. Winter spores.

Uromyces. Link. Clover Rust

Aecidiospores in cup-like bodies with an evident pseudoperidium; uredosori powdery; uredospores 1-celled with several evident germ pores; teleutosori powdery; teleutospores 1-celled, separate, pedicellate, apex with a single germ pore; sporidia flattened on one side. About 250 species widely distributed. Many of the species produce serious diseases of cultivated plants, as *Uromyces pisi* upon the pea, the alfalfa rust, (*U. striatus,*) and the bean rust, (*U. appendiculatus* (Pers. Lev.) There are many other species found upon our wild plants. Some of these, when they occur upon forage plants, may cause mycotic stomatitis.

Uromyces Trifolii. (Hedw.) Lev.

Aecidia in circular areas of pale colored spots; pseudoperidia short, cylindrical, flattish; edges, whitish, torn; spores sub-globose or irregular, finely roughened, pale orange; 14-23 μ in diameter; uredosori pale brown, round, scattered, surrounded by the torn epidermis; spores round or ovate, roughened; 20-26x18-20 μ with 3 or 4 germ pores; color brown; teleutosori small round almost black; long covered by the epidermis; spores globose, elliptical or subpyriform occasionally with wart-like swellings on the summit 15-20x22-30 μ; small dark brown in color; pedicels long.

Distribution. Widely distributed upon various clovers, especially red clover and the white clover. So abundant is this fungus at times that the plants are covered with the brown dusty material. Miss Howell reports it as very severe in the state of New York at times. The writer commenting on this fungus some years ago. said:

> The fungus did not occur until August and only on the "rowen" or "aftermath." Later it was found quite abundantly on the campus and College Farm. So severely did it attack some of the plants, especially the stems and leaves, that in touching the plants, the hands became covered with brown spores.

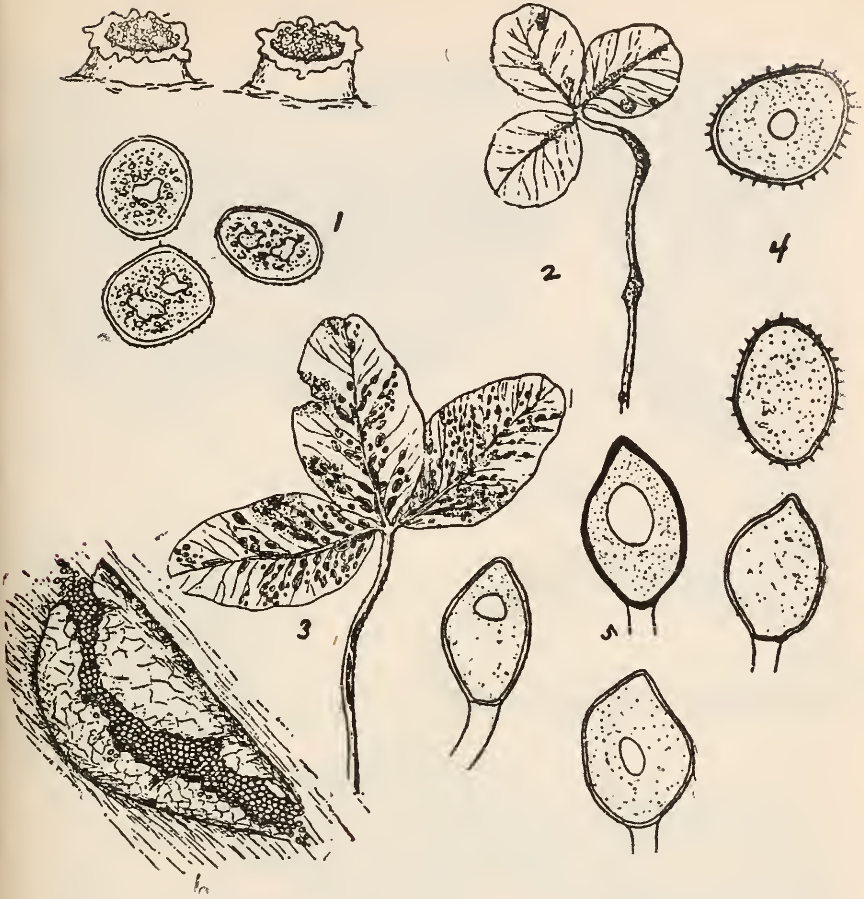


Fig. 67. Clover Rust. *Uromyces Trifolii.* (Hedw.) Lev. 1. Aecidium spores; above, two cluster cups in which the aecidiospores are found. 2. White clover leaf showing the distortions produced by the aecidium stage. 3. Red clover leaf showing clusters of uredo spores. 4. Uredo spores. 5. Teleuto spores. 6. An uredo cluster more magnified than in 3. Figs. 1, 2, and 3 after Miss Howell. Remainder by Miss King.

How long the fungus has affected clover plants in this country and especially in Iowa is not known.

Poisonous properties. Clover rust has been suspected of being injurious to cattle. Dr. John R. Mohler of the Bureau of Animal Industry, writes as follows with reference to mycotic stomatitis:

> Several attempts have been made by the writer to determine the exact cause and also to transmit the disease to other animals by direct inoculation, but with negative results. Suspicion, however, has been directed by various observers to the Uromyces and the red and black rusts that occur in clovers. These fungi cause very severe irritation of the lining membrane of the mouth, producing sometimes a catarrhal, at other times an aphthous, and occasionally an ulcerous stomatitis.

Considerable irritation of the nose and throat is experienced when rusty oats and wheat are threshed. Virchow records a case of severe inflammation of the nose of an old lady in which he found a great deal of *Puccinia graminis.*

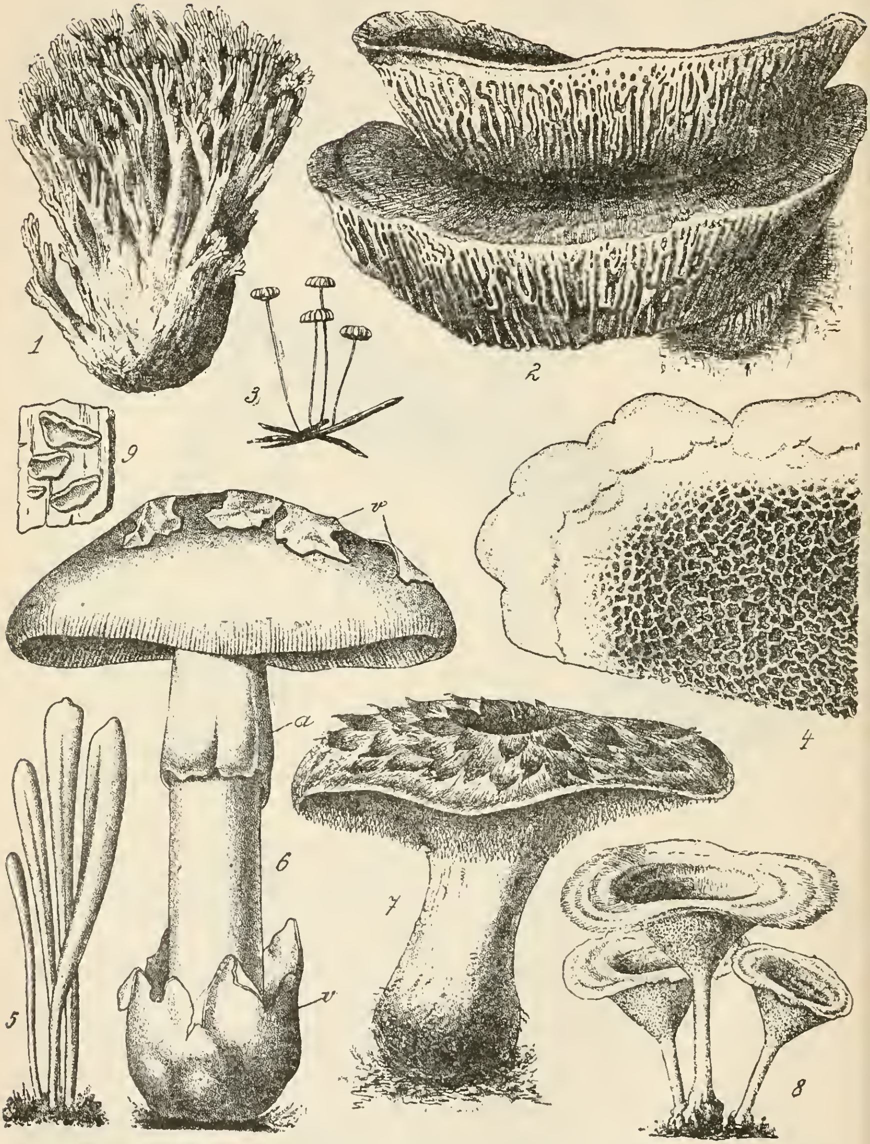


Fig. 68. Toadstools, Coral Fungi, &c. Hymenomycetes. 1, *Clavaria aurea*. 2. *Daedalea quercina*. 3. *Marasmius tenerrimus*. 4. Dry-rot Fungus (*Merulius lacrimans*). 5. *Clavaria argillacea*. 6. Poisonous Toadstool (*Agaricus caesareus*) *a* Ring; *v* *Vellum*. 7. Prickle Fungus (*Hydnum imbricatum*). 8. *Polyporus perennis*. 8. *Corticium amorphum* on wood. 1-4, 6-9 after Wettstein. 5 after Harper.

AUTOBASIDIOMYCETES

The basidia of the hymenium more or less club-shaped, undivided; sterigmata usually 4, occasionally 2, 6, or 8, coming from the apex of the basidium. The *Dacryomycetineae* with long club-shaped basidia and two long sterigmata. Basidiospores large; spores divided before germination; includes the group *Dacryomycetineae,* and an unimportant group, the *Exobasidiineae,* or small gall parasites containing the *Exobasidium* which occurs upon the cranberry and blueberry. The third group, *Hymenomycetineae,* contains a number of poisonous plants and will be treated more in detail.

HYMENOMYCETINEAE

Mycelium of septate hyphae, loose or delicate in texture or made up into strands or hard masses; hymenium at the time of spore formation free; the basidia form a definite layer or hymenium which may cover the whole surface of the fruiting body, or may be restricted to a definite portion; the fruit is made up of more or less closely compacted threads, hyphae, grown together, or it may be delicate and somewhat ephemeral; the hymenium may be free or gymnocarpous or covered from the beginning; the covering is called the veil, which consists of a layer of threads extending from the margin of the cap to the stem, or the veil may envelop the entire plant; the volva is an envelope which in the young stage completely covers the plant; at maturity it is left in the form of a cup at the base of the stem or distributed from the cap to the base of the stem; the annulus is a ring around the stem formed by

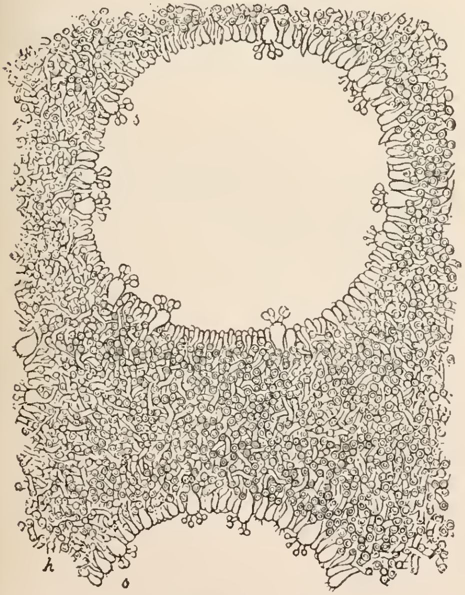


Fig. 69. Cross section of Bracket Fungus. *Polyporus igniarius.* *h.* Fungus threads, hyphae between the pores. *s.* Hymenium surrounding the pores; a number of basidia with spores. After Luerssen.

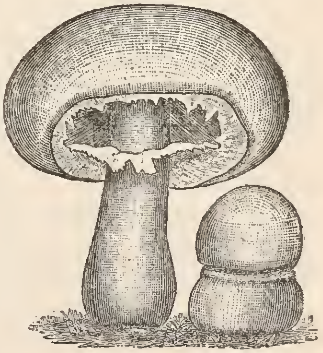


Fig. 69A. Mushroom (*Agaricus campestris*). To the left a matured plant and to the right a young plant. (Strasburger, Noll, Schenck and Schimper).

the inner or partial veil. Occasionally cystidia form in Coprinus; chlamydospores are seldom produced.

POLYPORACEAE

Hymenium usually below, porous, tubular, honey-combed, reticulate or of concentric plates; spores produced on the inner surface of the pores. A family consisting of 2300 species, of wide distribution. Some are edible like Boletus (*Boletus edulis B. scaber*) and others of this genus, as the Fistulina (*Fistulina hepatica*) also known as the vegetable beefsteak, and the Sulphur Polyporus (*Polyporus sulphureus*) when young. Several members are destructive wound parasites of trees. Among these are *Polystictus versicolor*; the common Bracket fungus (*Fomes applanatus*), and *Trametes radiciperda* found on the roots of conifers, and producing death. The dry rot fungus, *Merulius lacrymans*, is widely distributed and destructive to buildings.

Boletus. Dill. Boletus

Soft or fleshy, the stratum of the tubes on the lower surface of the cap easily separated. They are nearly all found growing on the ground and have the stem attached centrally to the cap. Quite a number of species are edible, some are bitter and some are poisonous. A small genus of 200 species found both in Europe and North America. The *Boletus edulis*, according to European authority, is one of the most desirable of edible fungi. Professor Atkinson lists this as one of the edible North American species. The *B. scaber*, also a North American species, is according to Professor Peck, first class, but several species are poisonous and bitter. The *B. luridus* is regarded as poisonous. The fact that a species turns blue when the plant is cut, should not be regarded as indicative of its poisonous qualities, for this is due to the oxidation process of the fat in contact with the air.

Boletus felleus. Bull

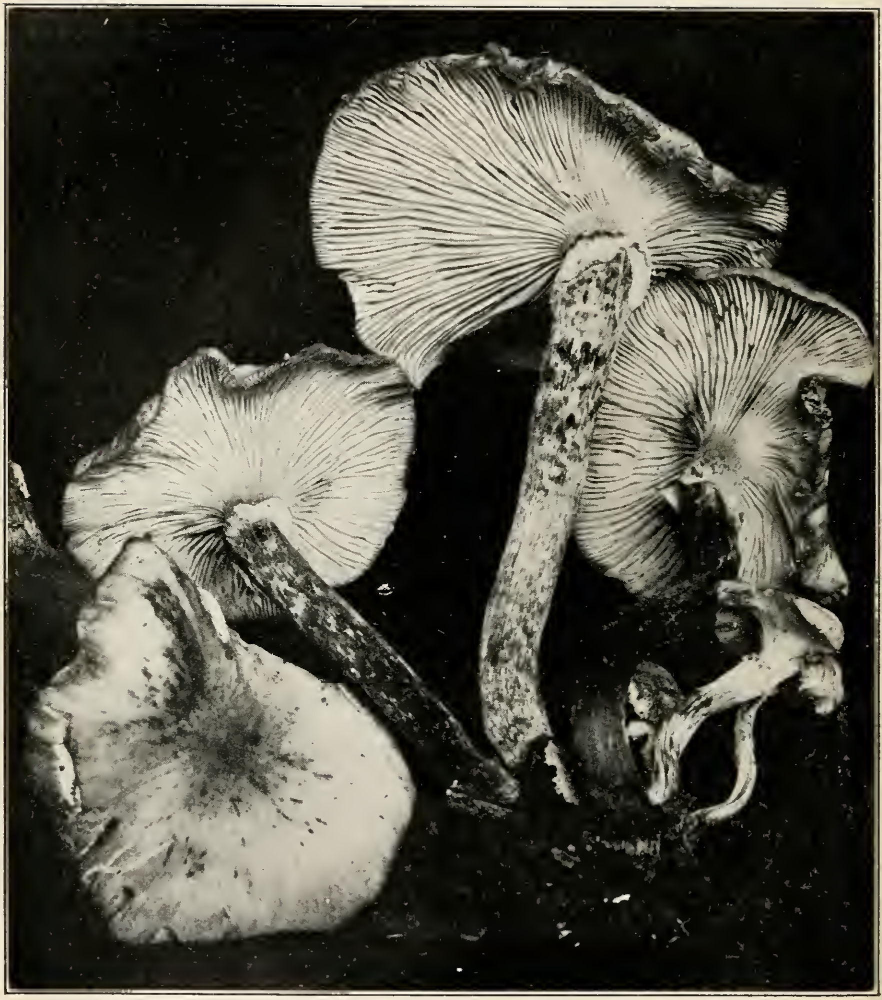
Pileus fleshy, convex above, glabrous or nearly so, grayish-brown, buff-brown, reddish-brown or tawny, flesh, white, taste bitter; tubes long, convex in the mass in mature plants, at first whitish, becoming pale flesh color; stem equal or tapering upwards, usually reticulated at the top only, rarely wholly reticulated, commonly a little paler than the pileus; spores oblong-fusiform, pinkish, .0005 to .0007 inch long.

Distribution. Widely distributed in woods and open places; found upon decayed stumps.

Poisonous properties. Prof Peck says:

> The Bitter boletus takes its name from the bitter flavor which its flesh persistently maintains. It is a common species, and one easily recognized by its reticulated stem and flesh-colored tubes taken in connection with its bitter taste.
>
> The cap is rather thick, dry and smooth, but quite variable in color. This is generally some shade of brown tinged with red or yellow. The flesh is white, but when cut or broken and exposed to the air it sometimes assumes a pinkish tint.
>
> The mass of tubes is generally somewhat convex in the mature plant, though it may be plane in the young plant. This also sometimes assumes a pinkish stain when bruised.
>
> The stem varies greatly in length and thickness, and is sometimes crooked and deformed. It is usually reticulated at the top only.
>
> The taste of the flesh in this Boletus, as well as in many species of Lactarius and Russula, is an important aid in the specific identification. In tasting fungi for this purpose care should be taken to select only fresh, sound specimens, and the part tasted should not be swallowed.

Mr. Hurd states that this species is not poisonous. No amount of cooking according to this author, will destroy the bitter flavor.



Honey colored Armillaria (*Armillaria mellea*). An edible species. (E. A. White in Conn. St. Geol. and Nat. Hist. Survey).

Boletus satanus. Lenz

Pileus large, yellowish-brown on its upper surface; lower surface blood-red at first, later becoming orange red; stalk yellow to reddish-purple with red reticulate markings; spores brownish ovate. Rank and unpleasant taste.

Distribution. In Europe and North America.

Poisonous properties. Said to be extremely poisonous. The *B. luridus* along with several poisonous species is eaten in Northern Russia. Ford states that these species may occasionally be the cause of transient disturbances in man and may occasionally cause fatal intoxication.

AGARICACEAE

Pileus generally expanded, stipe generally with central attachment, or nearly so, lateral, or sessile; gills simple or branched or anastomosing usually on the lower surface; lamellae folded or veined, radiating from the point of attachment; lamellae bear the basidia which in turn bear the four spores or rarely two, cystidia often present. A large order separated chiefly by the color of the spores. The *Melanosporeae* have their spores brown, purplish brown or black; in the *Ochrosporeae* spores are yellowish brown or rusty brown; in the *Rhodosporeae*, spores are rosy pink; in the *Leucosporeae*, spores are white, whitish or pale yellow. Many species of the family, like the cultivated mushroom, (*Agaricus campestris*), the field mushroom, (*Agaricus arvensis*), the shaggy-mane (*Coprinus comatus*, Fr.), *Lepiota procera*, and others, are edible. The *Rozites gongylophora* of Southern Brazil, is cultivated by the leaf cutting ants for food. No invariable rule can be laid down for the poisonous species. Many of the *Leucosporeae* are edible, but many are deadly poisonous. A few of the poisonous species are described later.

Amanita. Pers. Amanita

The young plants covered by a membrane which in the button stage is more or less free with the surface of the pileus; later when the stem elongates

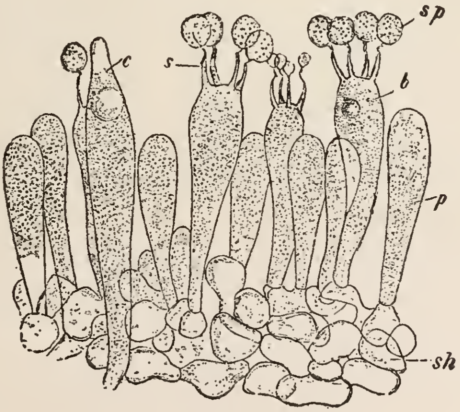


Fig. 70. Part of the hymenium of one of the Agaricaceae. *sh.* Sub hymenial layer. *b.* Basidium. *s.* Sterigmata. *sp.* Spores from basidium. *p.* Paraphyses. *c.* Cystid. After Bonn text book.

the volva is ruptured; stipe fleshy; volva and annulus present.

In some species the remains of the ruptured volva persist, forming a kind of cup or sheath. In others they occur in the form of small scales or warts on the cap.

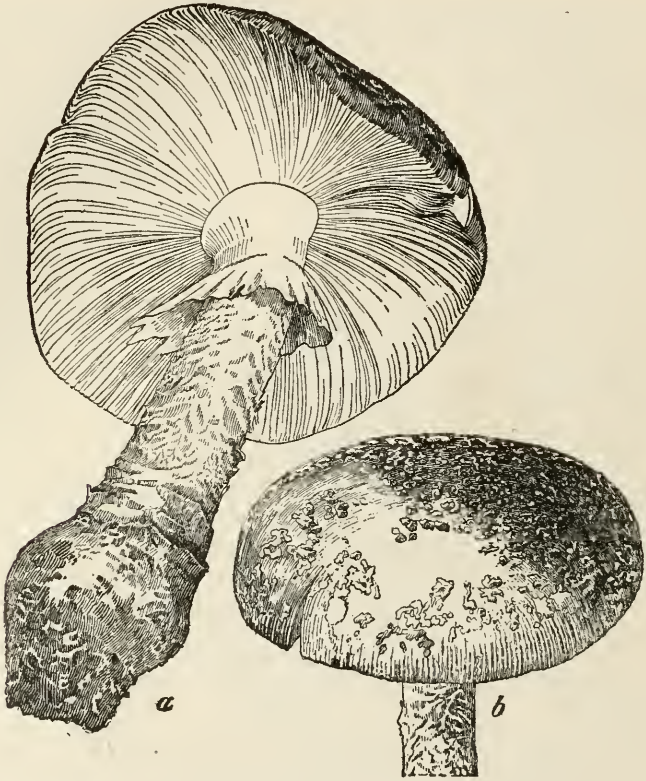
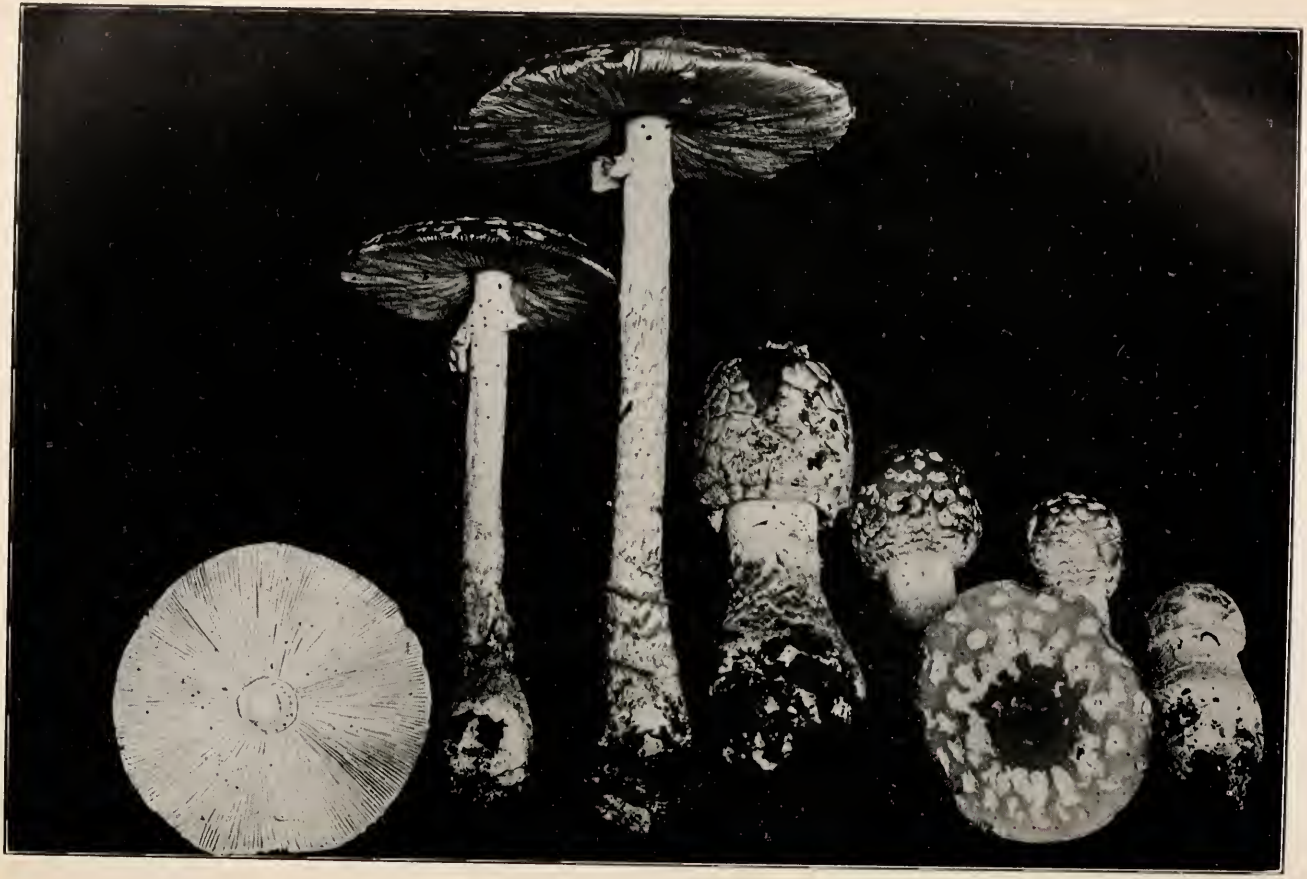


Fig. 71. Fly Agaric or Fly Amanita (*Amanita muscaria*). a. Mature plant. b. Top view of cap with scales. From U. S. Dept. of Agrl.

Amanita muscaria. L. Fly amanita. Fly agaric

Pileus nearly flat at maturity, warty, slightly striate on the margins, yellow to orange red, cap 3-8 inches broad; gills white or nearly so; stem 4-6 inches long, ½ inch in thickness, cylindrical, hollow, bulbous thickened at the base, which is more or less scaly from the fragments of the ruptured volva; spore broadly elliptical, white. Dr. Farlow gives the following excellent description of this fungus:

> The fly agaric (*Amanita muscaria*), so called because decoctions of it are used for killing flies, is in most places, at least in the northern and eastern parts of the country, a common species—often a good deal more abundant than the common mushroom. It is found during the summer along roadsides, on the borders of fields, and especially in groves of coniferous trees. It prefers a poor soil, of gravelly or sandy character, and occurs only exceptionally in the grassy pastures preferred by the common mushroom. It grows singly and not in groups, and attains a large size, being one of the most striking toadstools. It



Fly Amanita (*Amanita muscaria*). Very poisonous. (E. A. White in Conn. St. Geol. and Nat. Hist. Survey).

differs from the common mushroom in having gills which are always white, never pink or purple, and in having a hollow stem which is bulbous at the base and clothed with irregular, fringy scales on all the lower part. The pileus varies in color from a brilliant yellow to orange and a deep red, the yellow and orange being more frequent than the red. The surface is polished and has scattered over it a larger or smaller number of prominent, angular, warty scales, which can be easily scraped off. The gills and stalk are white, and there is a large membranous collar, which hangs down from the upper part of the stem. The general appearance together with the color of the pileus and gills noted above, are such that it is difficult to conceive how anyone who has ever seen a common mushroom or read a description of one could mistake this fly agaric for the mushroom. Nevertheless, in the writer's experience, no fungus is so often collected by mistake on the supposition that it is the common mushroom, and it is to the fly agaric that recent cases of poisoning in Washington, D. C., were due.

Distribution. Widely distributed in Europe and North America. Professor Coville, in speaking of this species after the death of Count Achilles de Vecchj, and Chung Yu Ting, says:

> The fly amanita is one of the largest, handsomest, and most dangerous of our mushrooms, and is the one whose character has been the most fully studied of all the poisoning species. It is abundant about Washington in the fall, growing in pine woods, a favorite situation in these woods being the vicinity of abandoned hog beds. The specimens that caused the death of Count de Vecchj came from a pine wood about a mile west of Fort Myer, between Balls Crossroads, and Columbia Pike.

Poisonous properties. The chief active poisonous principle of the fly amanita is an alkaloid called *muscarin*, but other poisonous substances, the chemical nature of which is not yet fully known, also occur in the plant.

Professor Atkinson, in discussing the Toxicology of the species, says as follows:

> The substance, *Cholin*, is of wide occurrence in the animal and vegetable kingdoms. It has been isolated from *Amanita muscaria*, *A. rantherina*, *Boletus luridus*, and *Helvella esculenta*. It is not very toxic, but on uniting with oxygen it passes over to *muscarin*. According to Kobert the substance formed from *cholin* on the decay of the mushrooms containing it is not *muscarin* but a very closely related alkaloid, *neurin*. This transformation of a comparatively harmless alkaloid to an extremely deadly one simply by the partial decay of the plant in which the former is normally found, emphasizes very much the wisdom of rejecting for table use all specimens which are not entirely fresh. This advice applies to all kinds of mushrooms, and to worm-eaten and otherwise injured, as well as decayed ones. *Neurin* is almost identical in its physiological effects with *muscarin* which is described below.
>
> Muscarin is the most important because the most dangerous alkaloid found in the mushrooms. It is most abundant in *Amanita muscaria*, it is also found in considerable quantity in *Amanita pantherina*, and to lesser, but still very dangerous extent in *Boletus luridus* and *Russula emetica*. It is quite probably identical with *bulbocin*, isolated from *Amanita phalloides by Boudier*. *Muscarin* is an extremely violent poison, .003 to .005 of a gram (.06 grain) being a very dangerous dose for a man. Like other constituents of mushrooms, the amount of *muscarin* present varies very greatly with varying conditions of soil and climate. This, indeed, may account for the fact that *Boletus luridus* is regarded as an edible mushroom in certain parts of Europe, the environment being such that little or no *muscarin* is developed.

Cases of Mushroom poisoning are frequent in some countries. Gaillard estimated the number of deaths in France at about 100 cases. Among the Americans deaths are not so numerous, although Palmer of Boston, has found 33 cases with 4 deaths.

Inoko of Japan, reports 481 cases in 8 years. The peasants of the Caucasus prepare an intoxicating beverage from *Amanita muscaria* from which many individuals die.

Muscarin acts on the nerve centers, but cases seldom terminate fatally.

Helvella esculenta owes its toxicty to *helvellic acid* $C_{19}H_{20}O_7$. Very few deaths have been reported in recent years.

According to Kobert, *Amanita muscaria* contains, besides *cholin* and *muscarin*, a third alkaloid, *fungus atropin*, (*pilz-atropin*); this alkaloid, like ordinary atropin, neutralizes to a greater or less extent the muscarin. The amount of *pilz-atropin* present varies, as other constituents of mushrooms vary, with varying conditions of soil, climate, etc., and it may be that in those localities where the *Amanita muscaria* is used for food the conditions are favorable for a large production of pilz-atropin, which neutralizes the muscarin, thus making the plant harmless. Be this as it may, *Amanita muscaria* is deadly as ordinarily found. It is undoubtedly used quite largely as food in parts of France and Russia, and it has been eaten repeatedly in certain localities in these countries without harm.

Ford suggests, on clinical grounds, that it may not be the only poison present because even when this drug is completely neutralized by its physiological antidote, atropin, the patient, who has eaten *Amanita muscaria*, sometimes dies.*

The alkaloid *muscarin*, a tasteless alkaline substance with a tobacco-like odor, causes the contraction of pupils; *amanitin* $C_5H_{15}NO_9$ is an isomer of *cholin*, and yields muscarin with nitric acid and cetraric acid, $C_{20}H_{18}O_{19}$ Muscarin has been obtained synthetically from cholin. It does not, however, produce quite the same symptoms.

Amanita Frostiana. Peck

Pileus convex to expanded, bright orange or yellow, warty, sometimes nearly or quite smooth, striate on the margin; lamellae white or tinged with yellow; stem white or yellowish, stuffed, bearing a slight, sometimes evanescent annulus, bulbous at the base, the bulb slightly margined by the volva; spores globose; 7.5-10 in diameter. From the character of the poisons it is quite distinct from the *A. muscaria*.

Distribution. New York to North Carolina.

Poisonous properties. Professors Peck and Atkinson both list it as poisonous. Ford found an hemolysin of low grade intensity. Heated extracts were without action upon animals. Schmiedeberg found a poison.

Amanita phalloides. Fr. Death Cup

Pileus smooth, fleshy, viscid, greenish, brown or olive to amber; cap 3-5 inches broad, frequently free from remnant of volva; lamellae white; stem 3-6 inches long, annulate; spores globose, white. Prof. Atkinson says: "The presence or absence of these scales on the cap depends entirely on the way in which the volva ruptures. When there is a clean rupture at the apex, the pileus is free from scales, but if portions of the apex of the volva are torn away they are apt to remain on the cap.

Dr. Farlow gives the following excellent description of this fungus:

> It is rather common and grows singly in woods and on the borders of fields, rarely appearing in lawns, and is not preëminently an inhabitant of grassy pastures, like the mushroom. It prefers a damper and less sandy soil than that chosen by the fly agaric. The pileus is often a shining white, but may be of any shade, from a pale dull yellow to olive, and when wet is more slimy than the mushroom or the fly agaric. It has no distinct scales and only occasionally a few membranous patches on the pileus. The gills and stalk are

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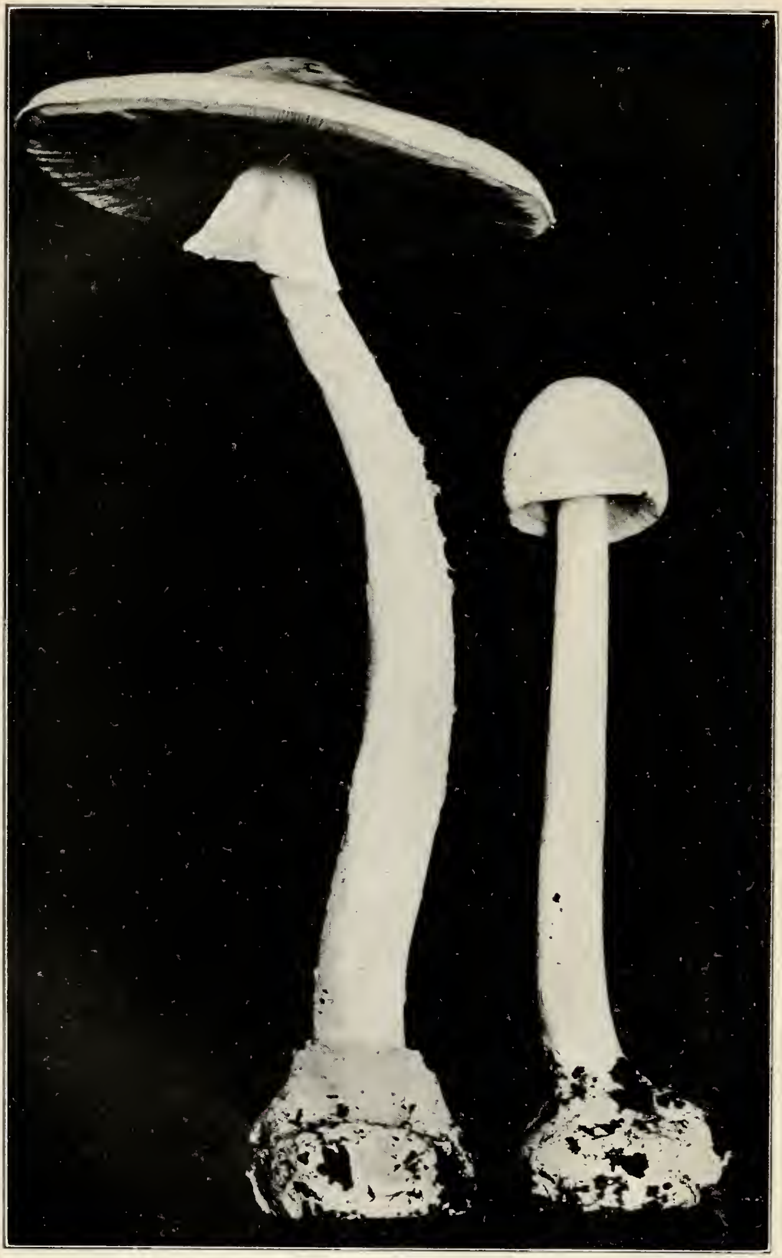
* Sci. 30: 97-108



Deadly Amanita (*Amanita phalloides*). A very poisonous species of toad stool, (E. A. White in Conn. St. Geol. and Nat. Hist. Survey, page 239).

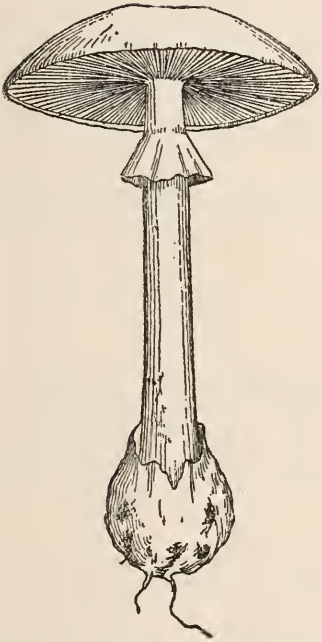


Fig. 72. Death Cup (*Amanita phalloides*) one-half natural size. From U. S. Dept. Agrl.

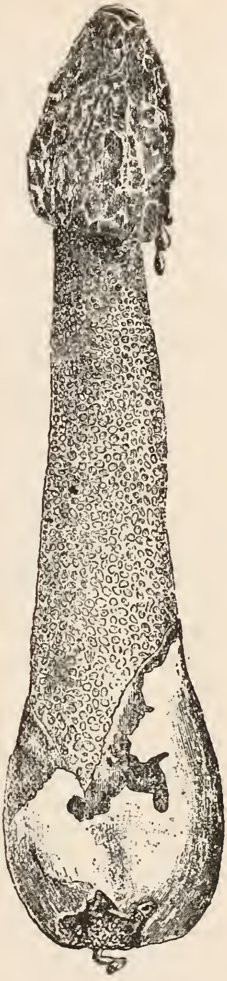


Fig. 73. Stinkhorn, *Phallus impudicus*. Common in some vineyards and fields.

white, and the latter has a large ring like the fly agaric, and is hollow, or, when young, is loosely filled with cottony threads, which soon disappear. The base of the stalk differs from that of the fly agaric in being more bulbous and in having the upper part of the bulb bordered by a sac-like membrane, called the volva. The volva is often of considerable size, but more frequently it is reduced to a membranous rim. In this species the stalk is longer and slenderer in proportion to the diameter of the pileus than in either the fly agaric or the common mushroom, and is buried rather deep in the soil or dead leaves, so that it often happens that the bulb is broken off and left behind when the fungus is gathered.

The following differences between the edible and two poisonous species are noted by Dr. Farlow:

(1) The common mushroom has a pileus which is not covered with wart-like scales; gills which are brownish purple when mature; a nearly cylindrical stalk, which is not hol-

low, with a ring near the middle, and without a bulbous base sheathed by a membrane or by scales.

(2) The fly agaric has a pileus marked with prominent warts; gills always white; a stalk, with a large ring around the upper part, and hollow or cottony inside, but solid at the base, where it is bulbous and scaly.

(3) The deadly agaric has a pileus without distinct warts; gills which are always white, and a hollow stalk, with a large ring, and a prominent bulb at the base, whose upper margin is membranous or bag-like.

(4) Other minor points of difference are the different places in which these species grow, and also the colors, which, although they vary in each case, are brilliant yellow or red in the fly agaric, white varying to pale olive in the deadly agaric, and white usually tinged with a little brown in the mushroom.

(5) A word should be said as to the size and proportions of the pileus and stalk in these three species. In the mushroom the pileus averages from 3 to 4 inches in breadth, and the stalk is generally shorter than the breadth of the pileus and comparatively stout. The pileus remains convex for a long time, and does not become quite flat-topped until old. The substance is firm and solid. In the fly agaric the pileus, at first oval and convex, soon becomes flat and attains a breadth of 6 to 8 inches and sometimes more. The stalk has a length equal to or slightly exceeding the breadth of the pileus, and is comparatively slenderer than is the common mushroom, but nevertheless rather stout. The substance is less firm than in the common mushroom.

(6) The pileus of the deadly agaric is thinner than that of the common mushroom, and from being rather bell-shaped when young, becomes gradually flat-topped with the center a little raised. In breadth it is intermediate between the two preceding species. The stalk usualy is longer than the breadth of the pileus, and the habit is slenderer than in the two preceding species. All three species are pleasant to the taste, which shows that one cannot infer that a species is not poisonous because the taste is agreeable. The fly agaric has scarcely any odor. The two other species have certain odors of their own, but they can not be described.

Distribution. Widely distributed in Europe and North America in woods, groves and pastures.

Poisonous properties. Professor Peck says:

The Poison amanita is very variable in the color of the cap, and yet is so definite in its structural characters that only the most careless observer would be likely to confuse it with any other species. There is, however, a sort of deceptive character about it. It is very neat and attractive in its appearance and looks as if it might be good enough to eat. This appearance is fortified by the absence of any decidedly unpleasant odor or taste, but let him who would eat it beware, for probably there is not a more poisonous or dangerous species in our mycological flora. To eat it is to invite death.

Professor Atkinson says:

Since the *Amanita phalloides* occurs usually in woods, or along borders of woods, there is little danger of confounding it with edible mushrooms collected in lawns distant from the woods and in open fields. However, it does occur in lawns bordering on woods, and in the summer of 1899 I found several of the white forms of this species in a lawn distant from the woods. This should cause beginners and those not thoroughly familiar with the appearance of the plant to be extremely cautious against eating mushrooms simply because they were not collected in or near the woods. Furthermore, sometimes the white form of the deadly amanita possesses a faint tinge of pink in the gills, which might lead the novice to mistake it for common mushroom. The bulb of the deadly amanita is usually inserted quite deep in the soil or leaf mold, and specimens are often picked leaving the very important character of the volva in the ground, and then the plant might easily be taken for the common mushroom, or more likely for the smooth Lepiota (*Lepiota nausina*), which is entirely white, the gills only in age showing a faint pink tinge. It is very important therefore, that, until one has such familiarity with these plants that they are easily recognized in the absence of some of these characters, the stem should be carefully dug from the soil. In the case of the specimens of the deadly amanita growing in the lawn on the campus of Cornell University, the stems were sunk to three to four inches in the quite hard ground.

The exact chemical nature of *phallin*, an extremely toxic substance, is not certainly known, but it is generally conceded to be of an albuminous nature. That it is an extremely deadly poison is shown by the fact that .0015 grain per 2 lbs. weight of the animal is a fatal dose for cats and dogs. It is the active principle of the most deadly of all mushrooms, the *Amanita phalloides*, or death-cup fungus. We quote again from Mr. Chesnut's account of *phallin* and its treatment: "The fundamental injury is not due, as in the case of muscarin, to a paralysis of the nerves controlling the action of the heart, but to a direct effect on the blood corpuscles. These are quickly dissolved by *phallin*, the blood serum escaping from the blood vessels into the alimentary canal, and the whole system being rapidly drained of its vitality. No bad taste warns the victim, nor do the preliminary symptoms begin until nine to fourteen hours after the poisonous mushrooms are eaten. There is then considerable abdominal pain and there may be cramps in the legs and other nervous phenomena, such as convulsions, and even lockjaw or other kinds of tetanic spasms. The pulse is weak, the abdominal pain is ripadly followed by nausea, vomiting and extreme diarrhoea, the intestinal discharges assuming the 'rice-water' condition characteristic of cholera. The latter symptoms are persistently maintained, generally without loss of consciousness, until death ensues, which happens in from two to four days. There is no known antidote by which the effects of *phallin* can be counteracted. The undigested material, if not already vomited, should, however, be removed from the stomach and intestines by methods similar to those given for cases of poisoning by *Amanita muscaria*."

Prof. Chesnut, writing in regard to the poisonous effect of this species, says that:

> The *phallin* spoken of is one of the toxalbumins, an extremely virulent poison found in poisonous animals especially the rattlesnake. These toxalbumins are allied to those found in diphtheria and other diseases produced by bacteria.

Other species reported as poisonous or probably poisonous are *A. floccocephala*, and *A. cothurnata*. Ford has shown that *A. spreta*, and *A. virosa*, *A. strobiliformis*, *A. chlorinosma*, *A. radicata*, *A. porphyria*, and *A. rubescens* are poisonous. The *A. verna*, a small spring form of *A. phalloides*, is also very poisonous.

Ford reports nearly 200 deaths since 1900 from this fungus in France, Germany, Italy, and England. Ford gives the pathological changes described by Maschka to be as follows:

1. Lack of post mortem rigidity.
2. Widening of the pupils.
3. Failure of blood to coagulate and a cherry-red color.
4. Ecchymoses and hemorrhages in the serous membranes and parenchymatous organs.
5. Dilation of the bladder with urine.

Studor, Sabli and Schören found extensive necrotic and fatty changes in liver, kidney, heart and voluntary muscles. The amount of fat in the liver is nearly as great as in phosphorous poisoning.

Clinical symptoms. Often latent period of from 6 to 12 hours during which the victims remain quite well. They are suddenly seized with terrible abdominal pain, excessive vomiting and thirst. Diarrhoea may set in with mucous bloody stools, or there may be constipation. The paroxysm of pain may be so severe as to result in a peculiar hipprocratic facies. The patients rapidly lose strength. In 3 to 4 days in children and 6 to 8 days in adults, coma develops, from which the patients cannot be aroused. Cyanosis and lowered temperature precedes the fatal exit. Ocular symptoms and convulsions do not ordinarily occur, but convulsions may be present on a terminal event. The mortality varies from 60 to 100 per cent.

Kobert obtained from *A. phalloides* a substance with marked hemolytic action, the dried extract dissolving ox blood 1 to 125,000. To this extract he gave the name *phallin*, which he considered a *toxalbumin*.

Later this author * found what he thought was a poisonous alkaloid, "that all typical forms contained an alcohol soluble poison;" that phallin was occasionally absent.

Ford found that the extract of the fungus is a powerful hemolytic agent and quickly destroys the erythrocytes of guinea pig, fowl, pigeon, dog, goat, and man. This takes place at 37 degrees C., slower at lower temperatures. The corpuscles of sheep, beef, and swine are resistent. Raw and boiled milk act as an antidote — they are antihemolysins. Animals may be immunized by using non-lethal doses.

Since the above has been written there have come to hand several recent papers by Dr. W. W. Ford,[1] who states that he found muscarin in several "yellow Amanitas" found in New York and Massachusetts. The aqueous extract of *Amanita muscaria* first agglutinated and then slowly dissolved blood corpuscles. The agglutinin was heat resistant. The extracts produced hemolysis. The agglutinin is a glucoside. The *Amanita solitaria* also contains an agglutinin. The *Amanita frostiana*[2] contains a moderately hemolytic substance and free from resistant toxin and muscarin. By the same author the poisonous nature of a number of species is reported as follows. The *A. phalloides* produces a chronic intoxication in guinea pig, the animal dying in twenty-five days. The lesion is typical for amanita toxin. It is hemolytic for rabbit's corpuscles, in a dilution of 1-20. The poison from *A. virosa* has a hemolytic strength of 1-200 in two hours and in dilution 1-100 at the end of 24 hours, and when heated to 60° C. Kills guinea pigs in twenty-four hours, with signs of acute intoxication. The *A. spreta* contains hemolysin and toxin but in rather a low degree. It should be classed with the deadly poisonous mushrooms. The *A. porphyria, A. strobiliformis, A. radicata* and *A. chlorinosma* are all poisonous and contain a heat resistant substance which induces in animals a chronic intoxication; the *A. vittadini* and *A. rubescens* should also be included according to Kobert.[3]

Dr. Ford in speaking of the poison in *A. phalloides* says:

> "In a series of investigations published from the John Hopkins University it has now been shown that *Amanita phalloides* contain two poisons which for the sake of clearness we speak of as the amanita-toxin.[4] The hemolysin is probably the same hemolytic substance which Kobert had in his preparation of phallin and the toxin is possibly identical with Kobert's second poison. The hemolysin was found in every specimen of *Amanita phalloides* which has thus far been examined, and when obtained from the fresh plant is the most powerful hemolysin of vegetable origin known. Drs. Abel and Ford[5] have shown that all coagulable proteid can be removed from this substance by uranyl acetate in alkaline solutions and by freshly prepared metaphosphoric acid, and when thus freed from proteid it continues to act upon blood corpuscles and gives the reaction of a glucoside containing a pentose. We have recently[6] developed a method for the isolation and purification of this glucoside which has an activity of 1-300,000 in the pure state. Since its sensitiveness to heat and the digestive ferments the hemolysin is precluded from playing any important role in human intoxication. We are inclined to believe that the amanita-toxin is the active principle, and Schlesinger and I[7] have shown that this poison can be isolated by certain well-defined methods. It also is one of the powerful organic poisons, four-tenths of a milligram killing

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* Sitzungsb. Naturforschenden Gesellsch Rostock 1899:26. Statement from Prof. Ford.

[1] The distribution of Poisons in Amanitas. The Jour. of Pharma. and Ept. Therapeutics. 1:275-284.

Notes on the Amanita-Toxin. Ford and Prouty. The Jour. of Pharm. and Expt. Therapeutics. 1:389.

[2] Jour. Inf. Dis. 4:437.

[3] Lehrbuch des. Intoxikationen. Ed. 2. 617.

[4] Ford. Jour. Expt. Med. 8:437, May 26, 1906.

[5] Abel and Ford: Jour. Biol. Chem. 11:273, Jan. 1907.

[6] Abel and Ford: Arch. f. Exp. Path. u. Pharmakol. Supplement-Band Schmeideberg Festschrift, 1908.

[7] Schlesinger and Ford: Jour. Biol. Chem. 3:279, Sept. 1907.

a guinea-pig in twenty-four hours. The amanita-toxin contains no proteid, does not respond to any alkaloidal reagents, and on fusion with potassium hydrate gives off idol and pyrol. At first thought to be a congugate sulphate, I have recently found in association with Mr. Prouty that this opinion is incorrect. We hope to ascertain the more exact characterization of this poison shortly."

Lepiota. Fr. Lepiota Toadstool

Plant with fleshy stem which can easily be separated from the cap; gills usually free from the stem; in some species the top of the cap breaks from the scales which adhere; volva absent. A small genus widely distributed. Some species are edible; *L. procera* is said to be excellent as food.

L. Morgani. Pk.

A large fleshy plant, sometimes a foot across the cap, with a thick stout stem and a ring removed a little distance from the gills; the pileus, when fully expanded, whitish, with dark scales; the spores and gills greenish.

Distribution. From Ohio southward and westward in grassy places, sometimes forming large fairy rings.

Poisonous properties. This plant is quite harmless to some people, but to others it causes very unpleasant symptoms. It should be eaten with caution.

Russula. Pers. Russula

Cap red, purple, violet, pink, blue, yellow, or green; pileus fleshy, convex, readily expanded and at length depressed; stem brittle, stout and smooth, spongy within and confluent with the cap.

Russula emetica. Fr.

Pileus fleshy, quite viscid, expanded, polished, shining, oval or bell-shaped when young, rose-red to yellow or even purple; margin furrowed, flesh white; gills free, equal, broad, distinct and white; stems stout, solid, or occasionally spongy; spores spherical.

Distribution. Widely distributed in North America. Found in pastures and under trees. Readily distinguished by viscid cap and color. Mr. Hand states that it is easily recognized by its acrid taste and free gills.

Poisonous properties. Mr. McIlvaine says that he has repeatedly eaten them and referred to a number of others who have also eaten them without any bad results, but Hand thinks that their acrid taste is against their use or rather cautions their use. Prof. Ford states that they cause profound gastro-intestinal disturbances, such as attacks of vomiting and diarrhoea, recovery only after thorough emptying of the stomach.

Volvaria. Fr. Volvaria

Universal veil forming a perfect volva, separate from outer part of the pileus; stem readily separated from pileus; gills free, at first white, then pink, and then reddish, and soft.

Volvaria bombycina. (Pers.) Fr.

This plant has a silky lustre; pileus is from 6 to 8 inches broad, globose, becoming bell-shaped, convex and somewhat umbonate; flesh white; gills crowd ed and flesh colored; stem is 6 to 8 inches long, tapering upward; spores rosy, smooth in masses and elliptical; volva large and somewhat membranaceous.

Poisonous properties. According to many authorities, this plant is edible, and it is likely that this and many other species can be eaten without serious trouble, although Gillot,* states that several species of this genus have caused death when eaten, though nothing is known of poisonous principle.

Inocybe Fr.

In the genus *Inocybe* there is a universal veil which is fibrillose in character, and more or less closely joined with the cuticle of the pileus, and the surface of the pileus is therefore marked with fibrils or is more or less scaly. Sometimes the margin of the pileus possesses remnants of a veil which is quite prominent in a few species. The gills are adnate, or sinuate, rarely decurrent, and in one species they are free. It is thus seen that the species vary widely, and there may be, after a careful study of the species, grounds for the separation of the species into several genera. One of the most remarkable species is *Inocybe echinata* Roth. This plant is covered with a universal veil of a sooty color and powdery in nature. The gills are reddish purple, and the stem is of the same color, the spores on white paper of a faint purplish red color.

Inocybe infida.

This is slightly larger than *Panaeolus papilionaceus*, with semiorbicular cap surmounted by a prominent nipple, which is dark reddish-brown, while the rest of the upper surface is light tawny-brown. The upper surface also differs from that of the non-poisonous kind in being silky-scaly and shining. The lower surface differs in being much lighter, pale yellowish instead of brownish-black, and the spore-print is about the color of oak wood.

Poisonous properties. Dr. William A. Murrill has recently contributed an account on the poisoning from *Inocybe infida*, a plant which closely resembles the *Panaeolus papilionaceus*. It appears that Dr. Deming of West Chester, who poisoned himself and other members of the family, describes the following symptoms: The fungi were gathered in the morning just before dinner. They were stewed and served on toast at one o'clock; he ate about half a slice of toast with mushrooms, drank some tea, and ate one-half a stuffed egg, with lettuce and mayonnaise dressing and after dinner smoked one-half a cigarette. Soon after he began to feel "queer," then there followed a fullness in the head and a rapid heart action as if he had taken nitroglycerin, this was followed by a sweat, his clothing becoming wet, and at the same time there was no nausea or prostration; his mind became a little bit confused. He then washed out the stomach, took castor oil and before the oil operated there was pressure and almost pain in the lower bowel. By evening he was as well as ever except somewhat exhausted. It appears that four other persons were affected with disagreeable symptoms from the eating of the mushroom.

Dr. Deming says: "In my case the beating of the heart, fullness of the head and sweating were very marked, though I ate about half as much as the others."

Dr. Murrill says that there is nothing to suggest an irritating poison and that it is probably not narcotic.

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* Etude medicale sur l'empoisonement par les champignons. Lyon, 1900.

PHALLINEAE

Mycelium consists of branched strands matted together; from this is produced an oval body consisting of an outer wall, the peridium, and an inner peridium; between the two is a layer of gelatinous material; the outer portion of the oval body forms the volva; the central portion pushes through the peridium with a long cellular stalk, the upper one bearing the cap-shaped gleba; the spores are brown on club-shaped basidia, surrounded by a mucilaginous material giving off an offensive odor. This sub-order contains the *Clathraceae* and *Phallaceae*. The *Phallus impudicus* and the *Mutinus caninus* have been regarded as suspicious.

CLATHRACEAE

Receptacle latticed or irregularly branched; gleba enclosed by the receptacle. The following genera of this order are known to occur in the United States, chiefly in the southern states: *Clathrus, Phallogaster, Simblum,* and *Anthurus.* Dr. Farlow * is authority for the report from Gerald MacCarthy to the effect that in North Carolina hogs had been killed by eating *Clathrus columnatus* which a correspondent, Mr. G. W. Lawrence found growing in oak woods near Fayetteville. The animals died within twelve or fifteen hours after eating the fungus. According to Gillot, hogs are poisoned by these and by Phalloideae.

PHALLACEAE

Receptacle tubular or cylindrical with an external gleba. The common Stinkhorn *Phallus impudicus* has a thick hollow stalk of whitish color perforated with pores; the upper part is honey-combed, resembling the morel. During the early stages, an egg-shaped body may be seen coming from a mass of white mycelium. The egg-shaped body is more or less mucilaginous and contains the stalk and gleba, the latter becomes exposed later. Flies, attracted by the carrion-like odor and mucilaginous material of the gleba, scatter the spores and, apparently, are not poisoned. The fungus, however, is usually regarded as poisonous as are several related genera and species such as *Mutinus caninus.* The common Stinkhorn (*P. impudicus*) was formerly used as a salve in gout.

HYMENOGASTRINEAE

This contains the family Hymenogastraceae.. The sub-order Lycoperdineae includes two families, *Tylostomataceae* and *Lycoperdaceae.*

LYCOPERDACEAE

Fruiting bodies globular, oval or pear-shaped, solid and fleshy, often of great size; before maturity, a dense white mass of homogenous hyphae occurs; the fruit is surrounded by a peridium, in some cases double; the interior is made up of branched threads called the capillitium, containing the spores; fruiting bodies break open in various ways at maturity. This group contains several interesting families. Many of the *Lycoperdaceae* are well known; among these are the Earth-star (*Geaster*), the *Lycoperdon giganteum* and

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* Farlow, W. G. Poisonous Nature of *Clathrus columnatus.* Bot. Gaz. 15:45-56. See also Halsted, B. D.., Rept. N. J. Agrl. Exp. Sta., 1894:417.

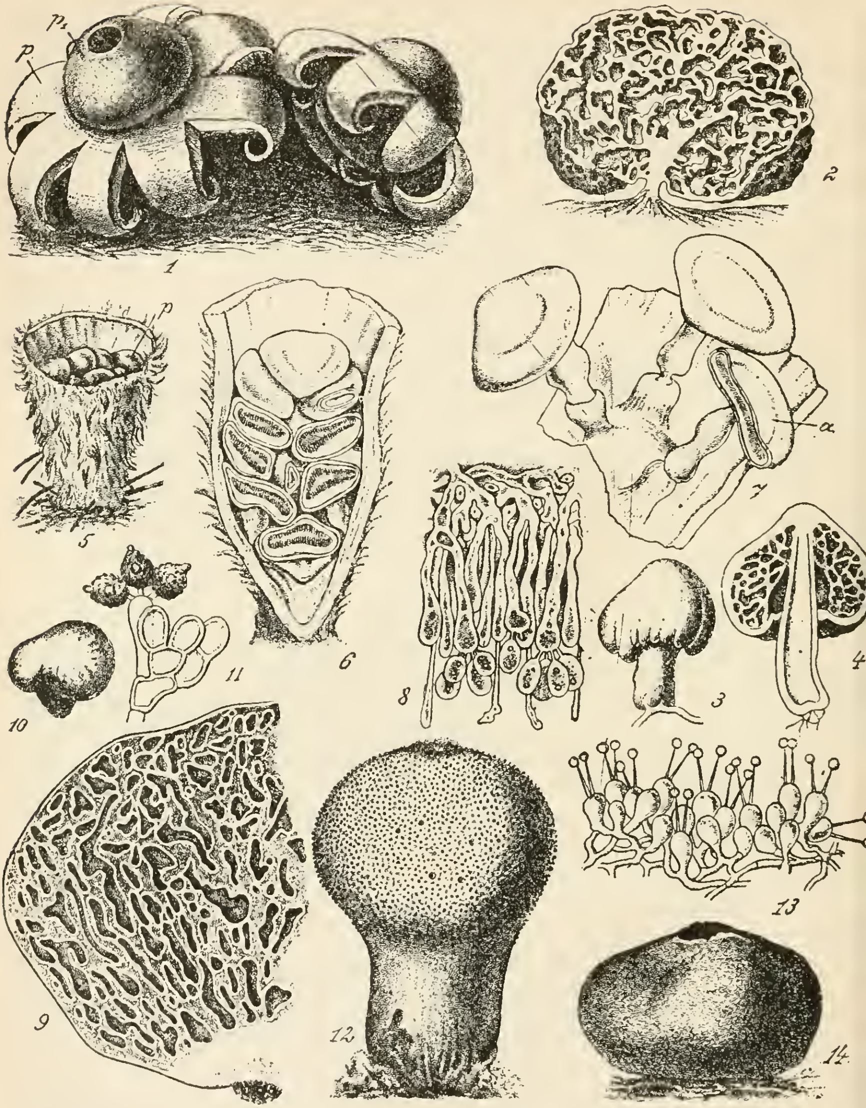

Fig. 74. Puff balls and their Allies. Gasteromycetes. 1. *Geaster fimbriatus*, *p* Outer peridium, *p*1 Inner peridium. 2. *Gautiera morchallaeformis*, sectional view of fruiting body. 3. *Secotium erythrocephalum*. 4. Sectional view of the No. 3. 5. Bird's Nest Fungus (*Cyathus striatus*), *p* Peridia of spore bearing body, the outer peridium open on top showing attachment of fruiting bodies. 7. The same showing three fruiting bodies attached to wall. 8. *Crucibulum vulgare* showing hymenium and spores. 9. *Hymenogaster tener*, sectional view of fruiting body x 3. 10. Same, natural size. 11. Basidia with spores of No. 9. x 450. 12. Puff-ball (*Lycoperdon sp.*), natural size. 13. Part of hymenium of *L. excipuliforme* with basidia and spherical spores. 14. Common Lead-color Puff-ball (*Bovista plumbea*), natural size. 1 after Kerner, 2 after Vittadini, 3, 4, 6, 7, 9,-11 after Tulasne, 8 after Sachs, 12-14 after Wettstein.

Dr. Miquel lists the *Lycoperdon Bovista* as poisonous; this and *Lycoperdon cyathiforme* are edible when fresh, but poisonous when the plants are mature.

NIDULARIACEAE

This is allied to the above and contains the Bird's Nest fungus. (*Crucibulum vulgare*), which occurs upon wood and manure, and the *Cyathus striatus.* The false truffle (*Scleroderma vulgare*) belongs to an allied order.

ASCOMYCETES

Mycelium many celled, branched; reproduction both sexual and asexual; spores known as ascospores, limited in number. Arranged in two divisions, the *Hemiasci* and the *Euasci.*

Hemiasci

Parasites or saphrophytes; reproduction generally asexual, in fertilization, the contents of the antheridium and the oögonium fuse.

HEMIASCALES

An unimportant group with three orders, *Ascoideaceae, Protomycetaceae,* which contains some plants that are parasitic, *Protomyces macrosporus,* upon the members of the carrot family.

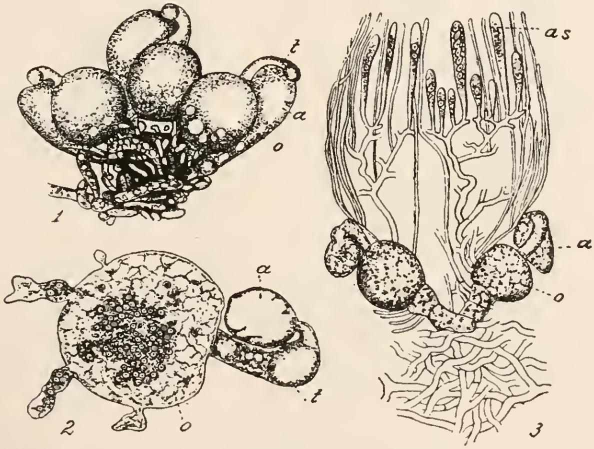

Fig. 75. Fertilization of *Pyronema confluens.* 1. Three oogonia (*o*) with fertilizing processes (*t*) a—antheridia. 2. Oogonium after fertilization, with numerous nuclei. 3. Part of fruiting body, the ascogonium forming hyphae (*as*), (*a*) antheridium, (*o*) oogonium. 1-3 greatly magnified. After Harper.

The family *Monascaceae* contains one fungus which has been found in mouldy corn and silage in Iowa, the *Monascus purpurens* Went. It is related to the *M. heterosporus* (Harz) Shröter, which was found by Harz in a soap factory. The coloring matter from *M. purpurens,* known as "ang-quac," is used in Eastern Asia as a pigment, being produced by the growth of the fungus on rice. The fungus consists of a mass of septate hyphae, producing conidia and perithecia with numerous asci; the ascospores are from 5-6.5 μ, in diameter. The details of the structure of this fungus have been given by Olive,[1] Barker,[2] and Ikeno[3] and in a paper to be published by Dr. Buchanan. Dr. Buchanan found this species in spoiled corn silage, which was responsible for the death of several horses in Iowa. This species possibly has been the cause of the disease, this fungus occurring only where air had access to the silage. The fungus found by Harz produces a mycelium similar to the preceding with thick-walled swellings and color white or carmine red; conidia ellipsoidal, spherical, obovate, of two kinds, the smaller 2.5-3 μ. to 7-8 μ, occurring in chains or singly, the larger occurring singly 9-11 μ in diameter, and arising from lateral branches; sporangia from short lateral branches are spherical 40-53 μ in diameter, many spored; the sporangia are surrounded by branched hyphae, ascospores spherical or oval, colorless 4-5 μ in diameter; conidia and hyphae contain a carmine red pigment *physomycin.*

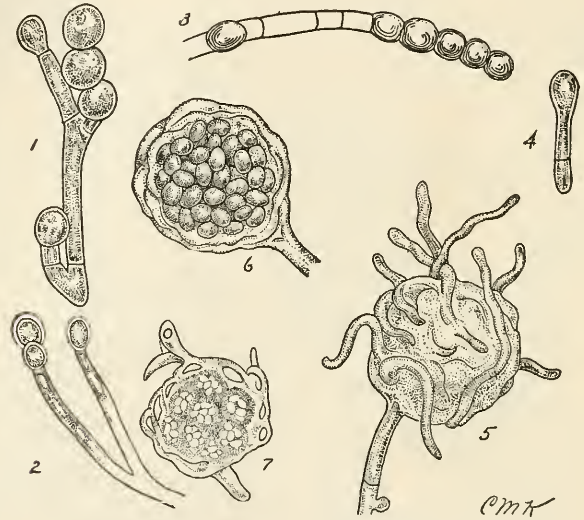

Fig. 75A. Corn Silage fungus (*Monascus purpureus.*) 1, 2, 3, Conidiophores with conidia; 4, germinating conidium; 5, sterile hypha covering of perithecium sending out branches, these are sometimes tipped with conidia; 6, optical section of mature perithecium, spores still within asci. Found in corn silage by Dr. Buchanan.

Euasci

Asci with definite number of spores, usually 2, 4, 8, 16, 32; seldom, but occasionally 1-celled.

EUASCALES

Contains the yeast plant, peach curl, plum pocket, ergot, blue mould, powdery mildews, etc.

PROTOASCINEAE

Asci single, in one group, without distinctive development of the mycelium; in the other with a distinctive mycelium bearing the asci with their spores.

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[1] Annals of Bot. 17:167, pl. 12 &13.

[2] Bot. Gazette. 39:56.

[3] Ber. deutsch Bot. Gesellsch. 12:259.

SACCHAROMYCETACEAE.

Vegetative cells single or in small groups; mycelium usually not evident, reproduction, by budding; ascospores, usually 4, produced in the cell; occasionally 8, 3, 5, or seldom 1.

The Saccharomycetes are fungi important in the process of fermentation. It is only in recent years that any parasitic species has been recognized. Metchnikoff, in 1884, found a parasitic yeast *Monospora bicuspidata* in Daphnids. Raum and Neumayer in 1891 declared yeasts were pathogenic. Busse, 1894, demonstrated that certain yeasts were pathogenic. Tokishige about the same time observed a yeast pathogenic for horses. Sanfelice isolated from the cancerous-like growth of an ox a Saccharomyces which was pathogenic for guinea pigs. The same author found another species in pigeons. Lydia Rabinowitsch studied 50 species of yeasts, of which 7 proved to be pathogenic. In 1895 Prof. Curtis found the second case of Saccharomyces in a young man; clinically the disease resembled a myxosarcoma. It is doubtful whether these forms are true yeasts. Some of these appear to be Hyphomycetes rather than Saccharomycetes. I have therefore discussed these under the form genus Oidium.

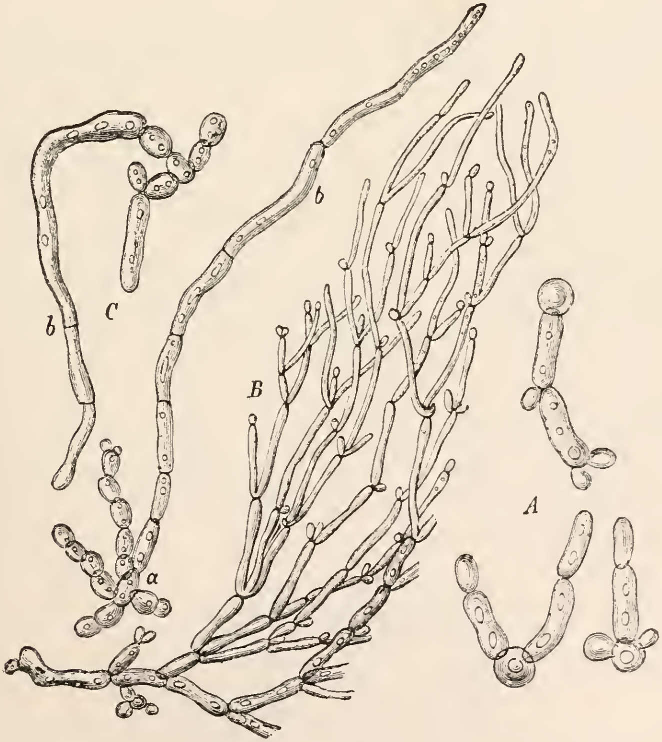

Fig. 76. Yeast. *Saccharomyces mycoderma*. A. Process of germination. B. Mycelium budding in a weak nutrient solution. C. (*a*) Yeast-like form budding; (*b*) long cells.

Saccharomyces. Meyen. Yeast

Vegetative cells spherical, ellipsoidal, oval or pear-shaped, occasionally elongated mycelial like; asci spherical, ellipsoidal or cylindrical with 1-8 ascospores 1-celled spherical or ellipsoidal. About 40 species. The *S. apiculatus,* Rees, is important in the fermentation of fruit. The *S. ellipsoideus* causes the fermentation of wine. The *S. mycoderna,* Rees, forms a white mass on cider, wine, cucumbers, etc., and prepares the way for the acetic acid fermentation. The *S. kefyr,* Beyerinck, along with *Bacillus acidi-lactici* and other bacteria is found in Keyfr grains. *S. glutinus* Fres., the pink yeast, is found growing on nutrient media in laboratories.

Saccharomyces cerevisiae, Meyen. Common yeast

Vegetative cells, spherical or oval, 8-10x8-12 μ singly, or in several, budding chains with one or more vacuoles; asci spherical or short elliptical 11-14, generally with 4 ascospores tetradform. It produces a white growth on gelatine and potato, does not liquify the gelatine; causes fermentation of grape sugar, maltose and cane sugar. The biology of the fermentation of beer is as follows: Barley, which is ordinarily used for this purpose, is allowed to germinate; during the process of germination the starch, by means of diastase, is converted into sugar, the sugar being afterwards removed with the water; this sugary fluid is then placed in large vats in dark rooms at a comparatively low temperature; the yeast plant is added and fermentation starts.

The fermentation of sugar is due to an enzyme found in the yeast plant, to which Buchner has given the name of Zymase. This enzyme breaks the sugar into alcohol and carbon dioxid. It is not necessary to have the living organism present to produce this fermentation, as a quantity of the yeast extract mixed with the solution of fermentible sugar will produce at the end of some days a small amount of alcohol. The enzyme decomposes very rapidly. Reynolds Green, in his book on fermentation, says:

> From these researches it appears certain that the production of alcohol whether in the presence or absence of oxygen is brought about by the activity of an enzyme. Its secretion by the cells of yeast attends the ordinary nutritive processes as well as the abnormal decompositions set up by incipient asphyxiation. The latter condition induces its formation in other parts of plants. The absence of oxygen stimulates the protoplasm of the cells to secrete it, the ultimate effect of its appearance being the liberation of energy as already stated.

Distribution. Widely distributed.

Poisonous properties. The chemical composition of alcohol is $C_2 H_5 OH$.

Different alcoholic drinks contain different percentages of alcohol. Ale and beers contain from 4 to 8 per cent together with bitters and malt extract; cider from 5 to 9 per cent; sherry from 15 to 20 per cent.

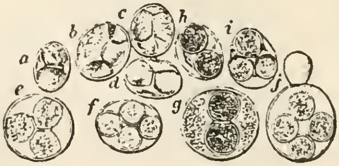

Fig. 77. Yeast. *Saccharomyces cerevisiae.* Ascospores in cells. Spores at *f.* Magn. 1000. After Hansen.

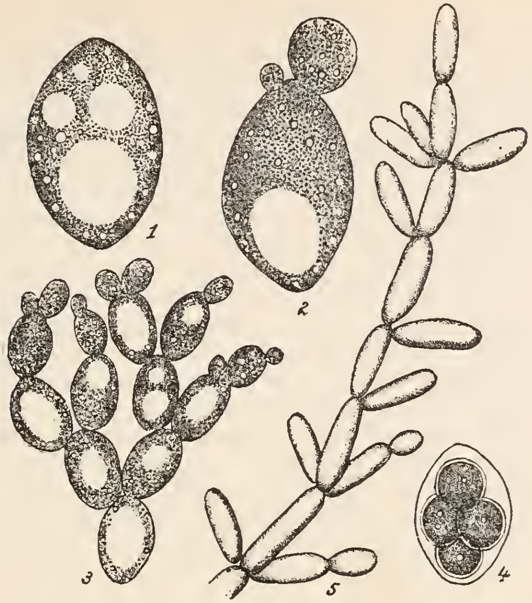

Fig. 78. Yeast. *Saccharomyces cerevisiae.* 1. Single cell with vacuoles. 2. Cells budding x 1500. 3. Numerous daughter cells x 1000. 4. Cell with ascospores x 1200. 5. *S. ellipsoideus.* 1-4 Modified from Luerssen and Rees; 5 after Hansen.

Alcohol in its action is a germicide and when applied to the raw surface or wounds it is a stimulant and local anaesthetic, while in concentrated form it is an irritant and even caustic. When placed upon surfaces of the broken skin it causes cooling and contraction of the superficial blood vessels. When absorbed it hardens the tissues. Internally it causes a secretion of saliva and the heart is stimulated by the irritative action of alcohol.. In large amounts it destroys the peptic ferment. Dr. Winslow says:

> Alcohol is essentially a heart stimulant and the most valuable one we possess. It makes the heart beat more forcibly and rapidly, and also increases blood pressure, despite the fact that, normally, alcohol causes dilation of the arterioles. In weakened bodily conditions, with vascular relaxation, alcohol may increase vascular tonicity. The heart and blood vessels are paralyzed by poisonous doses of alcohol and blood tension falls tremendously.
>
> The local effect of alcohol upon the peripheral nerves resembles the action after absorption upon the system generally. The nervous system is affected in nearly the same order and manner as by anaesthetics, and the same stages may be observed. The stages include the stimulant, depressant and paralytic. The law of dissolution is demonstrated by alcohol, as the more highly organized centres and those more recently developed in the process of evolution are first to succumb, and in following out this order, the medulla, the first of the higher centres to be developed, is the last to be influenced by the drug. In accordance with this law the cerebrum is first acted upon. The period of excitement is brief and is due in a considerable degree to the increased cerebral circulation and flushing of the brain. It is essential to emphasize the fact that by far the most apparent and decided action of alcohol is one of depression upon the nervous system as a whole. The stimulating influence of alcohol upon the spinal centres is more marked in the lower animals than in man because the brain is proportionately small and poorly developed in the former. The primary stimulating effect of alcohol is shown in man by increased mental activity and apparent brilliancy, but acute reasoning and judgment are not enhanced, and in many cases there is almost immediate mental confusion and drowsiness induced.

EXOASCACEAE

This small order contains parasitic and saprophytic species. The asci are without perithecium, except in *Gymnoascus* and *Ctenomyces* where there is a rudimentary perithecium. The *Taphrinae* are undoubtedly related to the yeasts and by some are placed in one order known as *Gymnoasceae,* being represented by *Gymnoascus.* The *Gymnoasceae* exclusive of *Taphrinae* are sometimes placed with the *Plectascineae,* a fungus occurring on the dung of horses and producing simple-fruiting organs, which consist of short-branched filaments arising either from a single hypha in which a cell is cut off, or several, one being spirally wound about the other. This becomes the ascus, which contains the ascospores. In *Eremascus* the ascus-producing part resembles certain zygospores. In *Ctenomyces* the ascus is surrounded by simple torulose hyphae, representing a rudimentary perithecium. The *Eidamella spinosa* described by Matruchot and Dassonville is allied to *Gymnoascus.* It produces numerous ovoid short stalked asci with 8 ovate colorless ascospores. Parasitic on dog. The life history of parasitic members of this order may be represented by *Exoascus pruni.* This fungus grows on the fruit of various species of the genus *Prunus,* producing in plums what is known as plum pockets or bladder plums. The fungus, when fully developed, consists mainly of a single layer of palisade-like asci, which produce their branching mycelium in the parenchyma of the affected part, and later develop between the outer walls of the epidermal cells and cuticle. Here

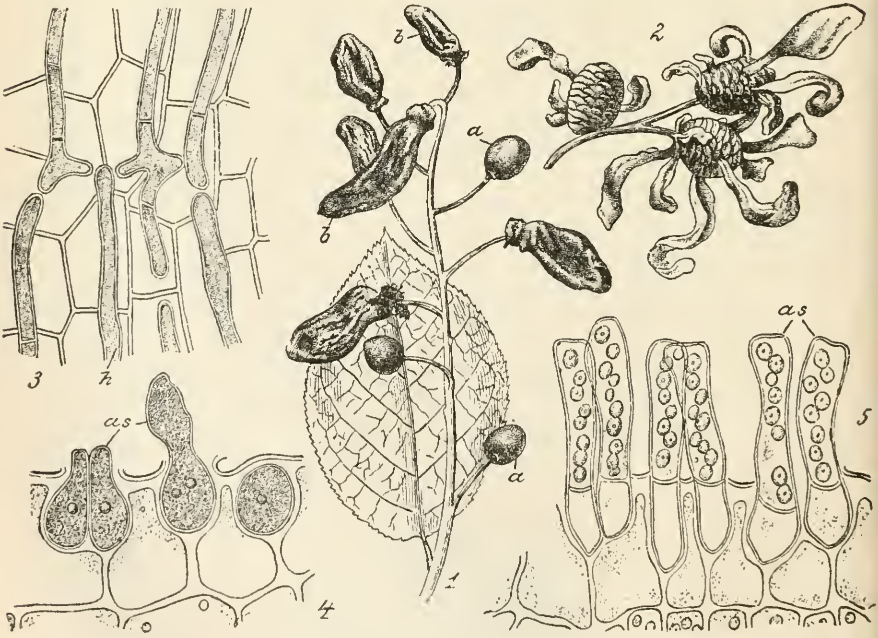

Fig. 79. Exosceae. 1. Plum pocket (*Exoascus Pruni*), on *Prunus Padus.* *a.* Normal fruit; *b,* abnormal fruit. 2. *E. Alni-incaniae* on alder (*Alnus incana*); scales enlarged. 3-5. *E. alnittorquus*; 3. Surface view, alder leaves showing hyphae (*h*) between cuticle and remainder of epidermal cell. 4. Formation of asci (*as*). 5. Ripe asci with ascospores x 100. 1-2 after Wettstein. 3-5 after Sadebeck.

they grow and spread out to the surface, forming a single layer of cells, each cell swells, the cuticle becomes ruptured and a palisade-like layer of asci is formed. There are eight ascospores in each ascus which escape by means of an opening at the tip. The ascospores of *Taphrina* frequently germinate in the ascus, budding like yeast and in this budding condition they produce a small amount of alcohol. Another troublesome species is the Peach Curl (*Exoascus deformans*) which occurs on the young leaves of peaches. The *E. Cerasi* is another destructive species producing the "Witches Brooms" of the cherry *Prunus Cerasus*. The *E. Betulinus* produces the "Witches Broom" in the Birches.

PEZIZINEAE, HELVELLINEAE, TUBERINEAE, PHACIDIINEAE

Mycelium well developed; asci borne upon large fruiting bodies and a continuous hymenium consisting of the asci, sterile threads, the paraphyses. Contains a number of common cup fungi like the *Peziza*, *Morchella esculenta*, and *Hellvella*. A *Sclerotinia* produces a disease on red mangolds, beans, and hemp; Sclerotinia also occurs upon clover and the common brown plum rot, (*Sclerotinia*). *Helvella suspecta* with a reddish brown pileus and a dirty flesh colored stalk is suspected of being poisonous. It has a nauseous, sweetish taste, and produces hellvellic acid, a hemolytic, or blood destroying substance. The *Gyromitra esculenta* also produces helvellic acid and is regarded as poisonous. It owes its toxicity to the blood making properties. The Hellvellas, Morels, and *Sclerotinia* belong to the family, *Helvellaceae*. Tuber produces tuber like bodies found in the soil. The organism is parasitic on trees. The fruiting bodies are enclosed by a peridium which consists of corrugated, smooth, or wart-like excrescences. The hyphae are compact. The ascospores occur in winding passages in the interior. Some of the Hellvellas and Morels are edible. The truffle (*Tuber aestivum*) of the family *Eutuberaceae* are edible.

The family *Phacidiaceae*, contains one important parasite of the alfalfa, the *Phacidium Medicaginis*. The diseased leaves turn yellow and soon fall. The yellow leaf, or in some cases the green leaves, contain the small blackish or brownish specks usually upon the upper side of the leaf, the injury extend-

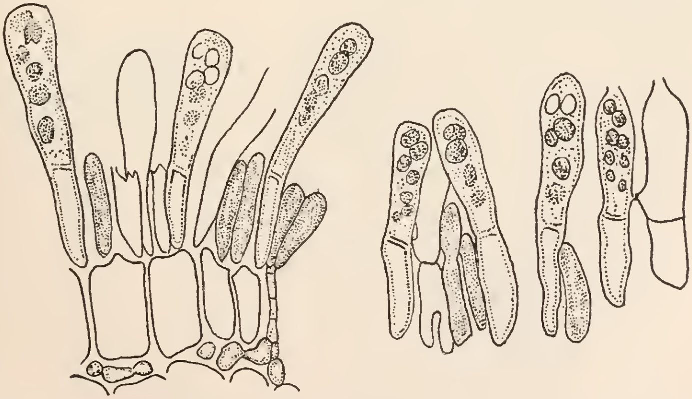

Fig. 80. Enlarged plum branches. *Exoascus communis* on *Prunus maritima*, projecting beyond the mass are the asci, some of which contain the spherical ascospores. After Atkinson.

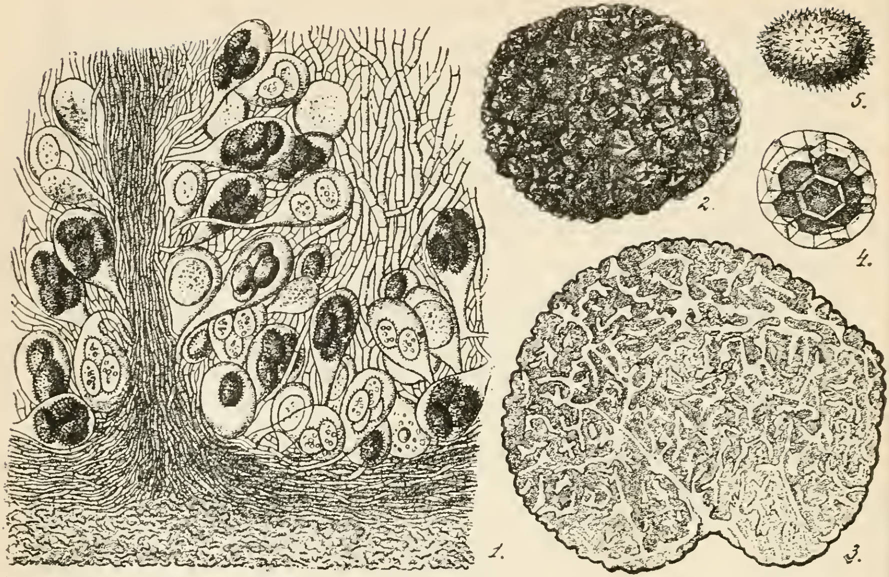

Fig. 81. Tuberaceae. Truffles. 1. *Tuber rubrum,* Part of interior of a truffle, showing hyphae, asci, and ascospores, greatly magnified. 2. *T. aestivum,* fruiting body. 3. *T. brumale,* section of truffle. 4. Ascospore of *T. Magnatum.* 1, 3, 5, after Tulasne. 2 after Wettstein.

ing to the lower surface. The spot contains a small pustule called the apothecium, which is cup-shaped. This cup-shaped body contains the asci (sacs) in which 8 small spores occur, the ascospores with the ascus, the two slender threads are known as paraphyses. This fungus is a serious parasitic disease of the alfalfa. The fungus does much injury to the fodder and it is not improbable that at times may be injurious to animals consuming the fodder.

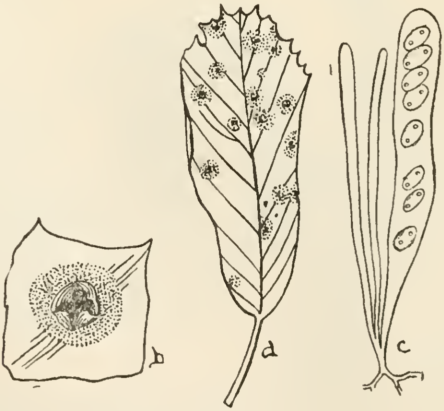

Fig. 82. Enlarged leaf showing spots. b. Single spot enlarged: c. Ascus with ascospores, paraphyses coming from mycelium.

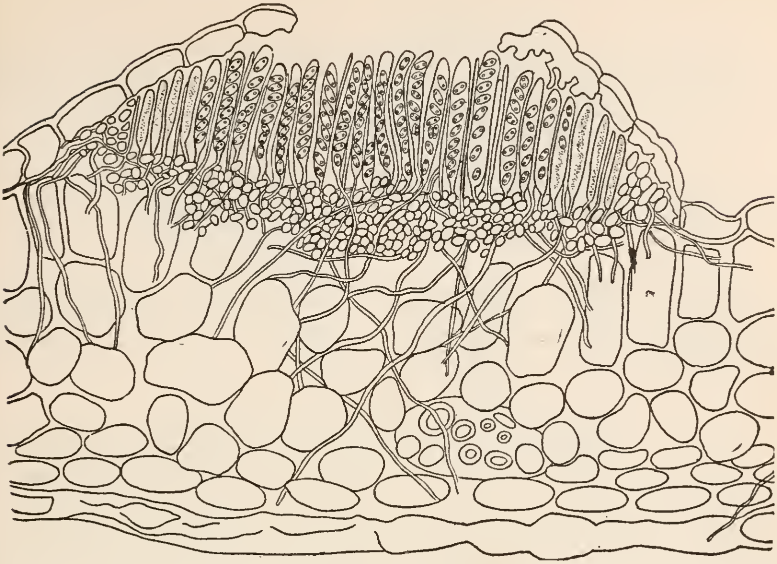

Fig. 83. Section through apothecium found on leaf; the asci, ascospores and mycelium. Combs.

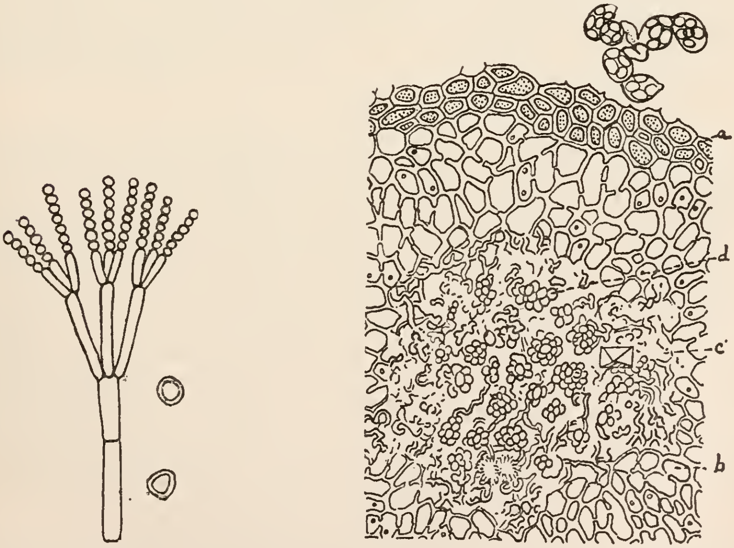

Fig. 84. Common Blue Mould (*Penicilium glaucum*). 1. Conidiophore, spores in chains. 2. Sclerotium or hard compact mass of fungus (threads hyphae) with asci and ascospores. Asci and ascospores shown above. Brefeld.

PLECTASCINEAE

Generally saprophytic fungi with a well developed mycelium, either buried in the sub-stratum or superficial. Reproduction sexual or asexual; asci either borne directly on the mycelium or in closed fruiting bodies, called perithecia.

ASPERGILLACEAE

Peridium thick; perithecia small; the sexual reproduction may be seen from the development as it occurs in the Blue Mould (*Penicillium*).

Penicillium. Link

A branched septate mycelium; conidiophores with septa, numerous branches near the apex; contains small flask-shaped sterigmata; spores borne in chains; conidiophores sometimes in bundles, as in the old Coremium; asci develop in poorly-lighted places in a sclerotium-like body.

Penicillium glaucum. Link. Blue Mould

At first a white mycelium spreads over the surface or through the substratum; the mycelium, through an enzyme action, undoubtedly, dissolves the starch; raised masses are formed on the surface, which consist of masses of mycelium thread strands; the strands send out lateral branches from the end of which a whorl of short branches appears, which give rise to one or more whorls; from the ultimate branches a chain of small spores is produced, the last one on the chain being the oldest.

The ascospores have not been found in corn, but occur in poorly lighted places and are produced in the absence of oxygen. The spores produced in chains germinate when the required amount of moisture and heat is present, so that unlimited numbers of generations may proceed from a single spore. These spores also preserve their vitality for a considerable length of time.

Brefeld has shown that they will germinate though kept in a dry place for several years. The organism grows at various temperatures, from near the freezing point to a considerable heat. It also resists antiseptics. It is one of the most troublesome fungi in stored fruit.

Penicillium glaucum is an organism which contains diastase, maltase, emulsin and a ferment which inverts cane sugar. *Calcium oxalate* is deposited in the perithecia. Under certain conditions mannite is said to be produced. When the *Penicillium glaucum* occurs in grape must it delays fermentation.

Distribution. The common blue mould is widely distributed in nature and is contained in a large number of the spores which drop in on fruits and decaying bodies and there germinate and produce fruiting bodies.

Poisonous properties. This fungus certainly is not pathogenic. It is widely distributed on decaying fruit; it has been suspected, in several instances, of being poisonous, but there is no evidence to support the supposition that this is the case or that it produces toxic substances. Under certain conditions it may, possibly, produce mycotic stomatitis. It has been found in sputum, nasal secretions, and in the stomach, but these cases are without special significance.

Penicillium minimum. Siebenmann

Mycelium at first white, flocculent, changing to blackish green when spores are formed; conidiophores slender, branching, bearing a chain of spores from 2-3 μ in diameter.

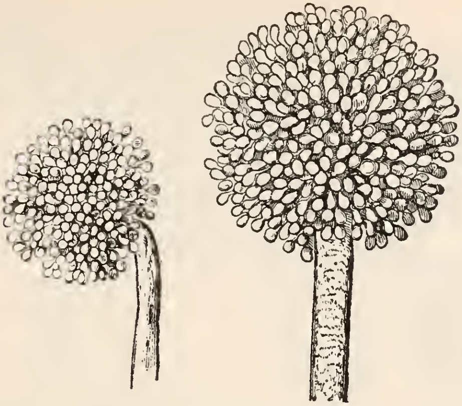

Fig. 85. Green Mould. (*Aspergillus glaucus*) on the left, *A. repens* on the right, both with conidia in chains, and conidiophores. After Siebenmann.

Distribution. Found in Europe.

Pathogenic properties. Found by Siebenmann in the ear.

Aspergillus. Micheli

Parasites or saprophytes with branched septate mycelium; reproduction sexual or asexual; in the asexual, conidiophores enlarged at the end, the enlarged portion bearing numerous small sterigmata, or these bearing smaller sterigmata; the conidia borne in chains; occasionally sclerotia form; perithecia small with asci and ascospores. The ascigerous stage of a few only is known. The life history of the common herbarium mould was first worked out by DeBary. A little known *A. sulphureus* is said to cause muscular contractions, and tubercular bodies.

Aspergillus glaucus. (L.) Link

Mycelium on or in the substratum forming a bluish green growth; conidia spherical or somewhat elliptical, slightly roughened, 6-15 μ in diameter, borne in chains attached to a short simple sterigmata; perithecia form little yellow masses; each ascus has 8 colorless biconvex ascospores 8-10 μ in diameter.

The life history of this fungus is as follows: This species is common in stored grain and hay. The mycelium spreads over the surface and through the substratum; it enters the kernel because of the dissolving action of an enzyme produced by the mycelium. From this mycelium erect threads (conidiophores or sporophores) arise which are enlarged at the end. From the enlarged portion of the conidiophores numerous small and radiating stalks (sterigmata) are produced, each bearing a chain of spores, the end spores of the chain being the older. These spores germinate under favorable conditions of moisture and heat, and again give rise to the same stage. In addition to this, the conidial stage, a second kind of reproductive body occurs. This is produced by the coiling of a branch of the mycelium having several turns. Two or three slender branches grow from the base. One of these grows more rapidly and connects with the top of the spiral coil formed first. The contents of those last formed

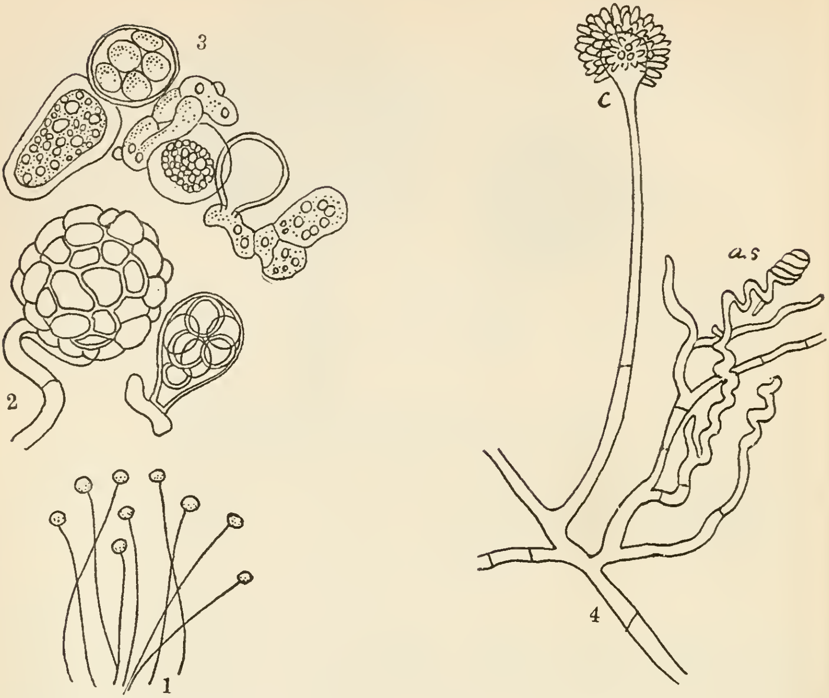

Fig. 86. Common Aspergillus. 1. General appearance showing long conidiophore and sterigmata on end. 2. Perithecia with one ascus and ascospores. 3. Contents from an unripe perithecium. 4. A small part of a mycelium with conidiophore *c* and spore-bearing sterigmata, young ascogonium *a, s*. All after DeBary except 1.

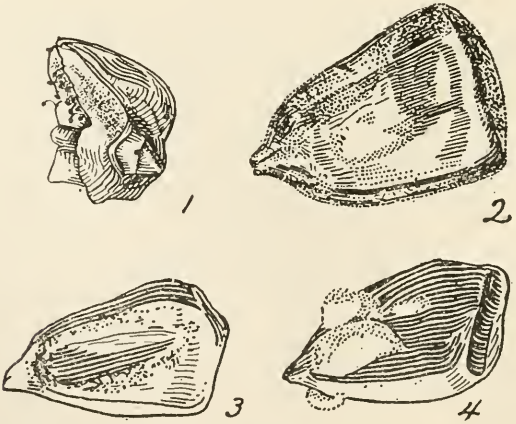

Fig. 87. Mouldy maize kernels. 1. Aspergillus (*Sterigmatacystis*). 2. *Aspergillus.* 3. *Rhizopus,* 4. *Pencillium.* Charlotte M. King.

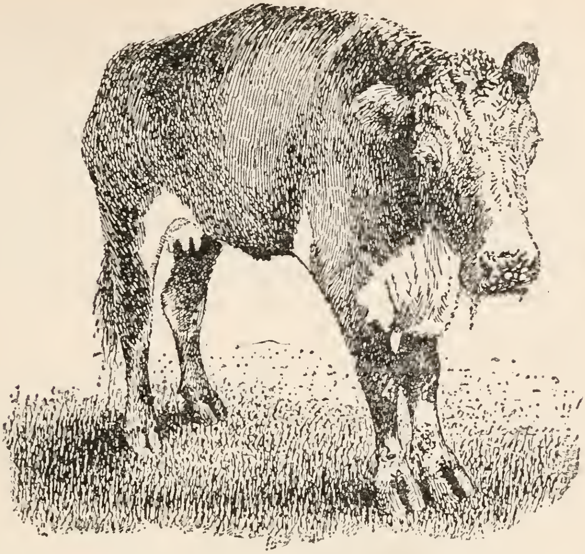

Fig. 87*a*. Mycotic stomatitis caused from eating mouldy hay and parasitic fungi on forage plants. (U. S. Dept. Agrl.)

unite with the spiral known as the ascogonium. After fertilization a perithecium is produced, which contains the asci, each ascus being surrounded by a delicate wall and containing eight biconvex ascospores.

Asperigillus forms diastase and is capable of changing starch into dextrin and maltose.

Distribution. Widely distributed in nature on mouldy hay, corn and other grains.

Poisonous properties. The organism is not pathogenic but probably develops a poisonous substance which may produce disturbance. Dr. Law mentions a serious case, epizootic cerebro-spinal meningitis, in Pennsylvania, due to the feeding of mouldy timothy hay, which was badly fermented. In Cairo, Egypt, 6,000 horses and mules perished from the same cause. Michener attributes this disease to foods undergoing fermentation due to toxic fungi. Williams, of Idaho, thought also that the fermentation of alfalfa, timothy and wild grass hay produced the disease. Dr. Law says:

> In all probability as we learn more of the true pathology of the disease, we shall come to recognize not one, but several toxic principles, and several different affections, each with its characteristic phenomena in the somewhat indefinite affection still known as cerebro-spinal meningitis.

It occurs in horses, sheep, oxen, goats, and dogs, preferably attacking the young which have not become immuned to the toxic substance. It occurs most commonly in winter and spring when animals shed the coat. Dr. Mayo, who investigated this trouble in Kansas, says that a disease known as "staggers," "mad staggers," or, as he has termed it, enzootic cerebritis, is caused by feeding corn which is attacked by *Aspergillus glaucus.* The spores of the fungus gain entrance to the circulation, and find lodgment in the kidneys and liver. He supports his conclusions by experiments made by him on a guinea pig and a young colt. He also quotes Kaufmann, who was successful in producing a disease with *Penicillium glaucum* and *Aspergillus glaucus.* There is considerable loss in many states from cerebro-spinal meningitis. In many parts of the country this is attributed, as I have said before, to mouldy corn. Dr. Bitting, of the Indiana Agricultural Experiment Station, made an investigation of this question and concludes that mouldy corn is not responsible for this disease. Upon an examination of mouldy corn he found several moulds and a bacterium. To test the poisonous properties of these, two horses were injected under the skin with five cubic centimeters. Later, larger amounts were given, and each animal was induced to eat as much as five pounds of the infected meal per day. One of the moulds as well as the bacterium gave negative results; the *Fusarium* produced a redness of the gums and some salivation. In no case did cerebro-spinal meningitis result.

The results of the experiment show that inoculations with culture of the bacteria and moulds were ineffective. Eating of the mushes containing pure culture showed that only in the case of a growth of a species of Fusarium did any intestinal disturbance follow, and that in one case the feeding of the rotted grain produced considerable intestinal disturbance and some nervous symptoms, but that the disturbance was light in the other.

Grawitz succeeded in producing infection by adapting the digestive tract of the animals to an alkaline medium.

Roberts and Bitting say in regard to this trouble in Indiana:

> It affects horses, cattle and sheep, but the cause is not known. This disease is reported in stables in the fall and winter. The reports indicate that about an equal number of horses and cattle become affected, but that they rarely become affected at the same time. The horses and cattle kept in the same barn and fed the same kind of food will not become diseased at the same time. Most of the cases occur while feeding ensilage or shredded fodder and thus it has come to be called ensilage disease and shredded fodder disease. The character of the food, however, is only an incident, for cases may occur when other spoiled or fermented foods are present, or when only the best foods are used. The disease is often ascribed to mouldy and rat-eaten corn, but our experiments with such foods and pure cultures of moulds from such foods were negative. Bad sanitation is also ascribed as a cause.

In regard to Mycotic Stomatitis of cattle which they attributed to moulds:

> The particular organism causing the disease, if there be one, has not been described. It seems probable that the disease is due to more than one form of fungi which may be present on the pasture. The animals affected are cattle of all ages above 4 months. The disease is not contagious, but usually affects a number of animals in a given herd, and always while in pasture. The fact of a number of animals being affected is due to similar exposure and not to infection spreading from one animal to another. Attempts at direct inoculation have not been successful. The disease occurs in some localities every year, and in others seemingly under special climatic influences. I know a locality where it may be developed at any time by permitting cattle to graze along the roadside. The disease is much more prevalent on permanent blue grass than upon timothy pasture, and is of rare occurrence upon pastures used in a crop rotation. The disease develops in pastures allowed to grow for some little time without being used. It is particularly liable to develop a few days after a good rainfall succeeding a dry period.
>
> The symptoms are inability to graze, saliva dribbling from the mouth, and frequent visitations to the watering trough, holding the mouth in the water as though it were burned. The animals appear to be hungry but cannot eat. The mouth is red and lips, gums and tongue swell. Blisters form and these soon give way to ulcers that may remain distinct or run together. In some of the aggravated forms the ulcers may unite so that when the crust comes off, it will make a cast of a lip or the whole end of the tongue. The crusts are usually from the size of a dime to that of a quarter. The tongue may swell to such an extent as to protrude from the mouth and the animal be unable to draw it inside. The muzzle may be increased one-half in size.

Dr. Craig, of the same state, reports somewhat similar experience.

Captain F. Smith, in his manual of Veterinary Hygiene, refers to the injuries from moulds, especially *Penicillium* and *Aspergillus*, calling attention to the brittleness of hay caused by fungi, and that the spores produce irritation to the respiratory passages. He states further that oats and bran have produced diabetes, paralysis, and subsequent death in horses. He refers to the case mentioned by Professor Varnell in which the horse died in three days from eating moldy oats. Professor Gamgee calls attention to the disease in France and Scotland in the years 1854 and 1856, due to horses feeding on grass which had become wet and musty. The animals suffered cerebral derangement, producing stomach staggers, so-called by English writers.

Aspergillus Oryzae. Ahlburg

Rabbits inoculated showed convulsive symptoms; tubular foci occurred in the intestines. The Aspergillus Oryzae forms maltose and diastase and in Eastern Asia plays an important part in the manufacture of "sake" or rice beer, which has been a national drink of the Chinese for centuries.

Aspergillus malignum. (Lindt.)

Mycelium bluish gray, conidiophores short, the end pear-shaped, 22-24 μ wide; sterigmata branching, conidia in chains 3-4 μ in diameter; perithecia 40-60 μ, ascospores 6-8.

Distribution. Found in Europe.

Pathogenic properties. Grows best at the higher temperatures. Found by Lindt in the human ear.

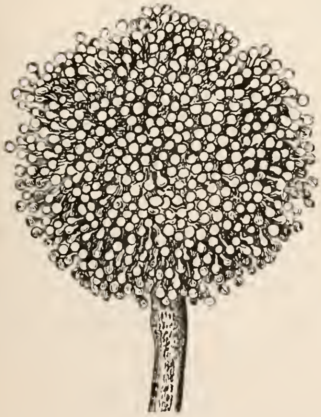

Fig. 88b. Pale Mould (*Aspergillus flavus*). Showing conidiophore and spores attached in chains. After Siebenmann.

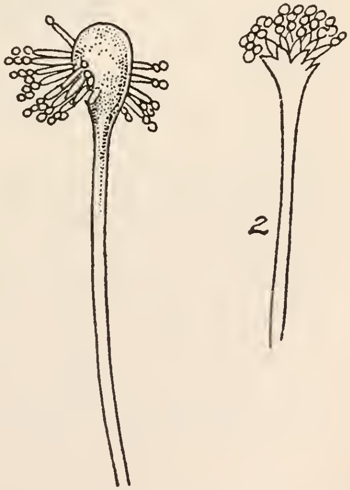

Fig. 88. *Aspergillus Oryzae* on rice. 1. Conidiophore, sterigmata and conidia 2. Young conidiophore. Modified by Charlotte M. King after drawing by Wehmer.

Aspergillus flavus. Link

Hyphae arachnoid, white; the fertile erect, slightly cespitose; conidia 5-7 μ in diameter, small, globose, vari-colored, slightly wart-like, collected about the white sub-globose, wart-like apex; apex finally becoming yellowish; sclerotium very small, dark.

Aspergillus fumigatus. Fresenius

Forms greenish or bluish gray masses on the surface of the substratum, conidiophores short with a semi-spherical mass 8-20 μ in diameter. Sterigmata bear the spherical conidia 2.5-3 μ in diameter, which are at first bluish green and later brown. Sclerotia unknown. Grows best at a temperature of 37-40° C.

Distribution. Widely distributed.

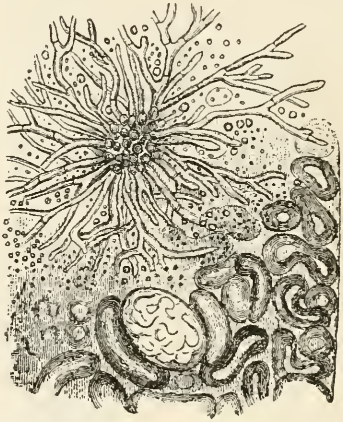

Fig. 89. Section of kidney of rabbit showing mycelium of an *Aspergillus*. After Grawitz.

Pathogenic properties. It has been known for some time that several species of Aspergillus are pathogenic for animals. In 1815 Mayer and Emmert found the fungus in the lungs of a jay. In 1826 it was reported in the long bones of a white stork by Heusinger, and numerous other cases in birds like the flamingo, duck, chicken, ostrich, and turkey, have been reported, especially in Europe. Kühn, in 1893, furnished quite conclusive evidence that certain species of *Aspergillus* can produce necrosis and disease. Chantemesse, at the tenth International Congress in Berlin, called attention to a disease of pigeons resembling tuberculosis which he said was produced by an *Aspergillus*. Saxer attributed mycosis to an *Aspergillus*, and, according to Sticker, the disease may appear sporadic and endemic, the latter to persons who feed pigeons and to the hair combers in Paris. It is spontaneous in horses, cattle, dogs, and birds, and is sometimes quite epidemic in birds. The form of the disease when it occurs in the lung is callel Bronchopneumomycosis; it appears that various species of Aspergilli also occur in connection with otomycosis, and occasionally in the nose or the eye. A very complete history is given by Drs.

Mohler and Buckley in the report of the Bureau of Animal Industry. Hughes Bennett reported a case in the sputum of a tubercular patient, and, in 1847, Sluyter reported definitely on the Aspergillus in the lungs of a human being. Virchow in 1856 reported several cases. In 1879, Leber first described a purulent keratitis due to aspergillus infection. Drs. Mohler and Buckley, in referring to the observations on pneumomycosis, say:

> Dieulafoy, Chantemesse, and Widal, reported their observations and studies of pneumonomycosis as it occurs in a certain class of men in Paris. These men feed thousands of young pigeons daily by taking into their mouths a mixture of grain and water which they force into the mouths of the birds much in the same way that the old pigeons feed their young. It had been a matter of common observation that these men were sufferers from a severe pulmonary disorder; but when their sputum was examined, instead of finding tubercle bacilli, only the threads of mycelia were detected. This observation was subsequently confirmed by Renon and other investigators. Until this time it had been held that the presence of fungi in the lung tissue was of secondary importance, but these observations dispelled further argument. Experiments on animals in which they were made to inhale the spores, were successful in producing the disease; thus it was that the natural infection was proved.

Renon, who made an exhaustive study of the subject, concludes as follows concerning aspergillosis:

> 1. That aspergillosis is a spontaneous disease affecting the bronchi and lungs of birds and animals, and creating in the animals a generalized affection similar to hemorrhagic septicemia; that it develops in eggs in incubation and may contaminate the embryos contained therein.
>
> 2. The disease may be transmitted experimentally. The botanical and cultural characters of the fungus and the lesions it provokes are truly specific. In its pathogenic action it bears a strong resemblance to tubercle bacillus.
>
> 3. In man it develops upon the cornea or skin, but has its particular evolution in the respiratory apparatus, creating pulmonary mycosis, resembling tuberculosis, and pulmonary gangrene, but without the fetid odor. It may coexist with tuberculosis. Occasionally it is fatal after the formation of cavities in the lungs. It may invade the bronchial apparatus alone, causing membranous bronchitis of special form and of long duration.
>
> 4. In all its manifestations *Aspergillus fumigatus* may play a primary or secondary role in both man and animals. It is not, therefore, a simple saprophyte, but a true parasite.

Renon points out the relation of the occupation of man to his contracting the disease. When animals and men are kept where the mould is common, as in hair assorting establishments where rye is used to disentagle the hair, they become affected with the disease. The handling of dusty grain and feeds may lead to infection from *Aspergillus.* Saxer also went into historical details giving his experiments with mycosis in man. In 1857 *Aspergillus* was observed by Rivolta in the pharyngeal abscess of a horse. Gotti observed it in an auricular catarrh of a dog. Pech observed mycotic pneumonia in seven horses, where they had been fed mouldy hay. Several cases where the *Aspergillus* occurred in the trachea of cows have also been reported. Pearson and Ravenel record a case of pneumomycosis of the lung of a cow.

Infection takes place generally by the inhalation of the spores. The spores germinate in the bronchial branches, develop a mycelium and produce conidiophores and spores on the surface. Drs. Mohler and Buckley, calling attention to the various aspergilli which have been found, say:

> Numerous experiments have been tried with the various fungi, especially in relation to the best temperatures for their development and fructification, and it has been found that, although a few are able to germinate in the bronchioles, the *Aspergillus fumigatus* is about the only one which develops a vigorous growth there and fructifies, the temperature of the human body seeming to be quite suitable for this species. Most of the other molds develop at a much lower temperature and are therefore usually harmless even if introduced

into the lungs. But for the *Aspergillus fumigatus* the lungs act as a veritable propagating house, furnishing a moist, nutrient soil upon which to grow and a congenial, warm, moist atmosphere with a sufficient amount of oxygen for its demand to come to complete maturity and for fructification to take place. When the fungous growth is localized in the bronchial mucous membrane, the condition is known as bronchomycosis. It may be that the tissues are able to forestall entrance into their substance and finally the fungi die and recovery takes place. In birds the growth may extend to the air sacs; this condition is then called cytomycosis. Cases of cytomycosis are very rare; and when it does occur, emaciation of the birds is the predominating symptom. When the lung tissue itself is the seat of invasion, the term pneumonomycosis is applied. Invasion of the lung tissue by the mycelium is the occasion for an intense inflammatory disturbance with positive chemotaxis. However, this tissue reaction seems to offer the most trifling barrier to the parasitic encroachment in such weakly subjects as birds. Generali states that delicate breeds of pigeons are noticeably susceptible to this disease.

In regard to the symptoms in birds, he says:

The birds become listless, mope, and do not follow the rest of the flock. When made to run they soon become exhausted and fall and have great difficulty in breathing. Even when disturbed they appear very weak and gasp for breath, extending their heads and making movements as if choking. There is a great thirst, but a diminution or complete loss of appetite. The birds become rapidly emaciated, the wings are pendant, the eyelids droop, comb and wattles become quite pale, and a general dejected appearance follows. Usually there is an intense diarrhea which weakens the bird very much. In the experimental disease the diarrhoea is an accompaniment just as in that of a spontaneous development, The plumage is said to appear ruffled, and the respirations become croupy, even when the disease has not advanced very far; later they are more rapid and a rattling noise can be heard. In the final stages suffocation is threatened.

When the air sacs are affected very few symptoms manifest themselves, though emaciation is marked. As in any similar condition of the lungs, fever is high, and symptoms that would be manifested in pneumonia of fowls would, of course, show here. There is more or less catarrh of the trachea and bronchi, and if these alone were diseased there would probably be nothing to attract notice other than symptoms of bronchitis. Bleeding from the nostrils has been observed in man and in animals, and it may be that this would also occasionally be seen in birds. If the air spaces in the bones become affected, lameness with swelling of the joints may result. The duration of the disease is quite variable and death may take place in from one to eight weeks from asphyxia or marasmus. Duration depends a great deal upon the portion of the respiratory apparatus that is affected; if the aspergillar nodules were localized in the mouth, as it is sometimes in pigeons, or in the bones or air sacs, the duration of the disease would, of course, be much longer than if in the bronchi or lung substance.

The pathological lesions are as follows:

The actinomycotic masses are noteworthy. The fungus may frequently become localized in kidneys, and muscles of heart.

The microscopic examination of these organs disclosed a picture simulating the gross appearance of an advanced case of pulmonary tuberculosis, with the exception that the bronchial tubes were almost completely plugged with a greenish velvety membranous lining.

In the bronchial divisions not wholly occluded by the croupous exudate are seen the characteristic aspergillar fruitheads in various stages of development, from that of a slight bulging end of the hypha to those giving off their spores. Included within this alveolar exudate are quite a few leucocytes and red blood cells, but their presence is by no means constant. The bronchial mucosa is often eroded and the lining epithelium replaced by a fibrinous coagula or by a membranous material composed of matted mycelial threads from which hyphae extend into the air space, forming spore-bearing fruitheads, owing to the presence of oxygen.

In animals in which the disease was experimentally induced by the injection of the spores into the blood vessels or into the lung substance, miliary lesions resembling tubercular formations were quite noticeable in the lung tissues, and in these an occasional giant cell was discovered. In the lungs of a chicken which was inoculated directly into the lung substance, an acute miliary pseudo-tuberculosis was produced, accompanied by intense hemorrhages into the interstitial tissues, as was also the case in intravenous inoculations. In these tubercular nodules penetrating filaments could be made out, but the spores could not be surely demonstrated, or at least differentiated from other cellular elements. Often the bronchial ramifications were the seat of hemorrhage, in which a noteworthy increase in the number of leucocytes could be observed.

In large rabbits the pathological lesions appeared to be as follows:

> Rabbit No. 1008 failed to show any marked symptoms for the first two weeks after inoculation. It then began to lose weight, and on the twenty-fifth day was chloroformed. The postmortem examination showed an involvement of the liver, spleen, kidneys, and abdominal serous membranes, as in the preceding rabbit, but to a less extent. The organs of the thoracic cavity were apparently normal.

The optimum temperature of growth for the fungus is from 35°-40° C. Ceni and Besta in their investigations isolated a toxin from two species of *Aspergillus*, the *A. flavus* and *A. fumigatus*. Dogs inoculated intra-abdominally with large doses died within a few hours, showing tetanic symptoms and general hyperemia of all the organs. This work has not, however, been confirmed. Drs. Mohler and Buckley did not succeed in producing serious symptoms with the filtered product when injected into rabbits.

The Aspergilli also produce disease of the eye but, according to Plaut, this disease is not of frequent occurrence; he discusses several cases under the head of keratomycosis. One case described by Leber is as follows: A farmer forty-five years of age, while threshing had the misfortune to have some chaff of oats thrown into his eye. The sclerotic coat became inflamed, followed by healing and total leucoma (leucom). Another case is cited where a pear was thrown against the eye of a farmer, and another case of a fifty-three year old patient, a miller by profession, who had a slight fever, his right eye becoming inflamed. The conjunctiva had the appearance of trachoma. The sclerotic coat was clouded and the surface of the eye brittle, consisting of threads of fungi. Fuchs, who investigated this case, determined that the fungus was *Aspergillus*. *Aspergillus fumigatus* has also been observed in the nasal cavities where it produces necrosis and a disagreeable odor.

In a review of a paper by E. Bodin and L. Gautier * the following statements are made with reference to the Toxin found in *Aspergillus fumigatus*.

> From a study of this fungus in cultures and in experimental animals it was found that *Aspergillus fumigatus* produces a toxin which may be rightfully compared with the toxins of bacteria. For the formation of this toxin in cultures it is necessary to have a mixture of protein, especially of the peptone type, and some carbohydrate, especially glucose saccharose, maltose, or dextrin. The reaction of the toxin must be either neutral or alkaline. The effects of the toxin are chiefly observed in the nervous system and are produced more or less rapidly by the method of inoculation. The symptoms of poisoning from the toxin are muscular convulsions resembling tetanus and leading to death within a few hours if the animal does not recover. The rabbit and dog are very susceptible to the toxin, while the guinea pig, cat, mouse, and white rat are more refractory. The dog and cat are naturally immune to the spores of *A. fumigatus*, but are quite susceptible to the toxin produced by the fungus.

Treatment: To prevent the disease, do not feed mouldy grain or fodder. Separate at once all diseased animals from the healthy. Use only thoroughly clean dishes; the troughs and boxes should be cleaned with formaldehyde.

Very little can be done in the way of treatment in the case of birds. Mohler and Buckley say that if a large number of birds are affected at one time, or if those affected are very valuable, treatment may be tried in the form of medicated vapors, such as those generated from wood tar or sulphur. A small quantity of wood tar is put in a pint of water and stirred with a redhot iron. The person doing the fumigating should remain in the room and immediately remove any birds that are overcome by the vapors. Burning sulphur or vapors of formalin may be tried in like manner. Hydrogen peroxid, solutions of potassium iodid, or hyposulphite of soda may be used as intratracheal injections, and in case of local nodules in the mouth or nostrils the tincture of iodine may be applied to them with beneficial results.

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* The Ann. Inst. Pasteur, 20 (106) No. 3, of the Experiment Station Record.

It appears from the investigations with reference to kerato-mycosis, that infection generally occurs through the medium of feed, straw, or something that is thrown forcibly into the eye. According to Plaut the simplest and surest method of dealing with the disease is to use a 2% solution of salicylic acid, three times daily, but inhalation of an atmosphere containing iodine is recommended by some of the German investigators, or the inhalation of etheral oils. Immunity cannot be obtained by beginning with the injection of small quantities of spores and increasing the dose. Dogs are not immune against aspergilli. Mice are immune.

Aspergillus niger. Van Tieghem

An abundant mycelium in the substratum and on the surface becoming blackish; conidiophores long; sterigmata branched; conidia 3½-4½ μ in diameter, roughened; spherical or cylindrical sclerotia. The fungus contains diastase, invertase, and emulsin; it breaks up tannin into gallic acid and glucose, and converts sugar into oxalic acid.

Pathogenic properties. This fungus has been found both in the lungs and the ear, although less pathogenic than the preceding species.

Aspergillus subfuscus. Olsen-Gade

Mycelium olive yellow or brownish when mature, in and on the substratum; conidiophores short, club-shaped; spores spherical, colorless.

Distribution. Found in Europe; closely resembles *A. fumigatus.*

Pathogenic properties. Pathogenic, but less so than the *A. fumigatus* or *A. niger.*

Aspergillus nidulans. (Eidam.)

The mycelium forms greenish masses; later the mass assumes a reddish color; conidiophores 0.6—8 millimeters long and 8-10 μ across, colorless, branched; sterigmata consist of a basal branching cell and two or more branches, each branch containing from 20 to 30 conidia; perithecia yellowish, 0.2—3 millimeters in diameter; ascospores 8.

Distribution. Found in Europe.

Pathogenic properties. The disease appears on the second day after inoculation in guinea pigs and death occurs in 60 hours. Kidneys are enlarged and show small white dots. White masses also occur in the peritoneum. It is pathogenic for cattle and man, and is occasionally found in the human ear.

PYRENOMYCETINEAE

An important division of the fungi, containing about 10,000 species, many of which are troublesome parasites on cultivated plants. The mycelium is composed of delicate distinct hyphae or of closely coherent threads, frequently forming a pseudo-parenchymatous tissue; hymenium enclosed in a subglobose envelope called a perithecium, or with an opening at the apex, which is often

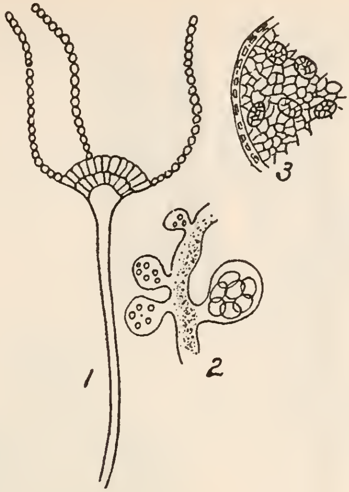

Fig. 89a. *Aspergillus nidulans.* 1. Conidiophore. 2. Branch of mycelium with asci and ascospores, magnified. 2. Asci. 3. Cross section. Ascus. All greatly magnified. (After Eidam.).

prolonged to form a short tube or beak; numerous transparent asci arise from the base of the perithecium, these contain the ascospores; between the asci slender filiform bodies, called the paraphyses. Polymorphic fungi with conidia, spermogonia, and pycnidia, supposed to be connected with the ascigerous stage. The formation of the ascospores is in some cases presented by the development of sexual organs in which genuine fertilization occurs. The reproduction can be illustrated by the manner in which it occurs in the powdery mildew of the lilac, *Microsphaera Alni.*

The mycelium spreads over the surface of the lilac leaf; the fungus draws its nourishment from its host by means of haustoria which penetrate the epidermal cells; the mycelium produces erect branches which bear these spores in a moniliform chain, the end spore being the oldest; these summer spores germinate immediately and propagate the fungus; later two hyphae cross and there arises an oval cell, the oogonium, which is separated from the hypha by a cell-wall at the base; from the same hypha springs a longer and thinner cell, also cut off by a cell-wall; this cell is above the oogonium, and is known as the antheridium; from the base of the oogonium other cells arise which soon enclose it; finally a brown perithecium is formed which bears dichotomously branched appendages; the perithecium contains the asci, in which are found the ascospores, which germinate, probably, in the spring. The accompanying figure after Harper illustrates the development.

Another type of one of the Sphaeriaceae, the *Gibbellina cerealis,* is common on stems of wheat where it produces at first a grayish brown circular spot, the mycelium frequently encircling the stem. The conidia are oval, the perithecia are immersed.

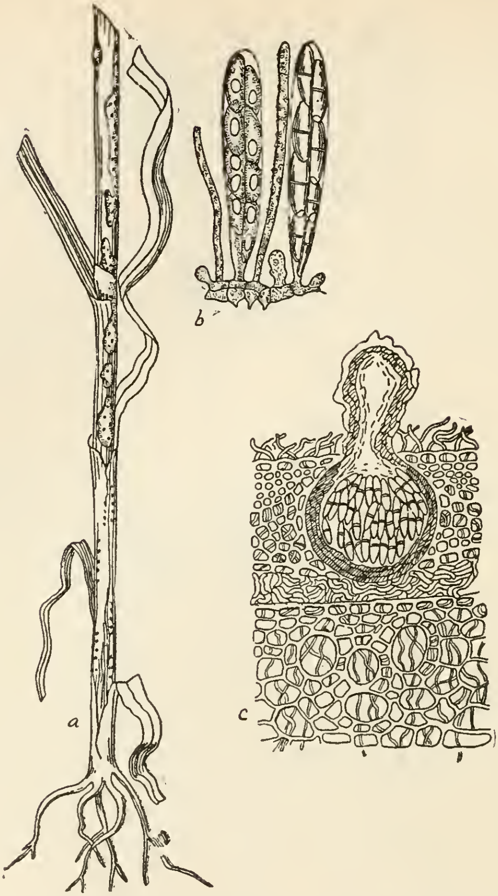

Fig 90. Stem Blight (*Gibbellina cerealis*), one of the *Sphaeriaceae*. *a*, general appearance. *b*, asci with ascospores and paraphyses. *c*, stroma, mycelium, and perithecium. After Cavara.

PERISPORIALES

Perithecia spherical, closed, or with the ostiolum obscure, coriaceous or brittle carbonaceous, opening irregularly, generally without stroma, but mostly seated on a well developed, superficial mycelium. This division includes the order *Erysibaceae.*

ERYSIBACEAE

Superficial mycelium, branching, septate, closely adhering to the surface by means of the haustoria; asci arising from the base of the perithecium, delicate, thin-walled, colorless, oblong, obovate or suborbicular, stalked, usually containing from 2-8 ascospores; perithecium spherical with appendages, without ostiolum; conidia (Oidium) simple, colorless, cylindrical, oval or ovate, borne one above the other on septate, colorless hyphae. Contains many important parasitic fungi, like the powdery mildew of the grape (*Uncinula spiralis*), mildew of lilac (*Microsphaera Alni*), mildew of sunflower (*Erysiphe Cichoracearum*), mildew of cherry (*Podosphaera tridactyla*).

Erysiphe. (Hedw.)

Perithecium containing several asci, appendages with simple threads, similar to and frequently interwoven with the mycelium. A small genus of 20 species of wide distribution.

Erysiphe communis. (Wallr.)

Amphigenous, mycelium abundant, persistent, or sometimes evanescent; perithecia variable in size and reticulate, appendages variable in length, often long; asci 4-8 or more, ascospores 4-8.

Distribution. Found on a large variety of different hosts but common on plants of the order of Leguminosae, especially the forage plants like the pea (*Vicia sativa*), bean, clover and other members of the clovers.

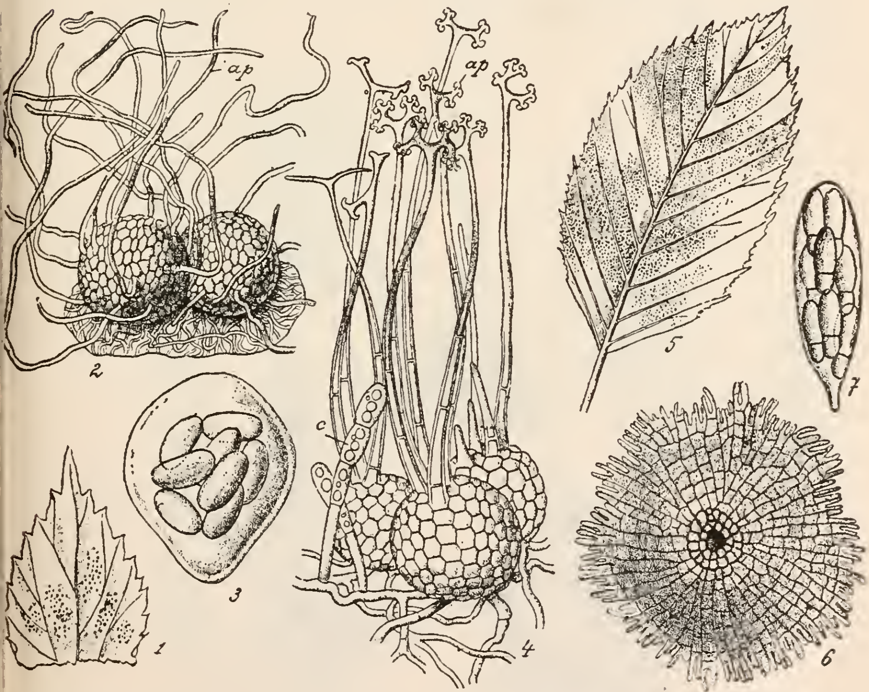

Fig. 91. Powdery Mildews. 1-3. *Sphaerotheca Castagnei* on Hop. 1. Part of leaf of hop with perithecia shown in the form of dots. 2. Perithecia with tortuous appendages (*ap*) x 175. 3. Ascus with spores within the ascospores x 380. 4. Powdery Mildew on Cherry (*Podosphaera tridactyla*), conidiophore bearing conidia (*c*). 5-7. *Microthyrium microscopicum.* 5. On leaf. 6. Perithecium, greatly magnified. 7. Ascus and ascospores. 1 after Wettstein. 2-4 after Tulasne. 5 after Lindau. 6-7 after Winter.

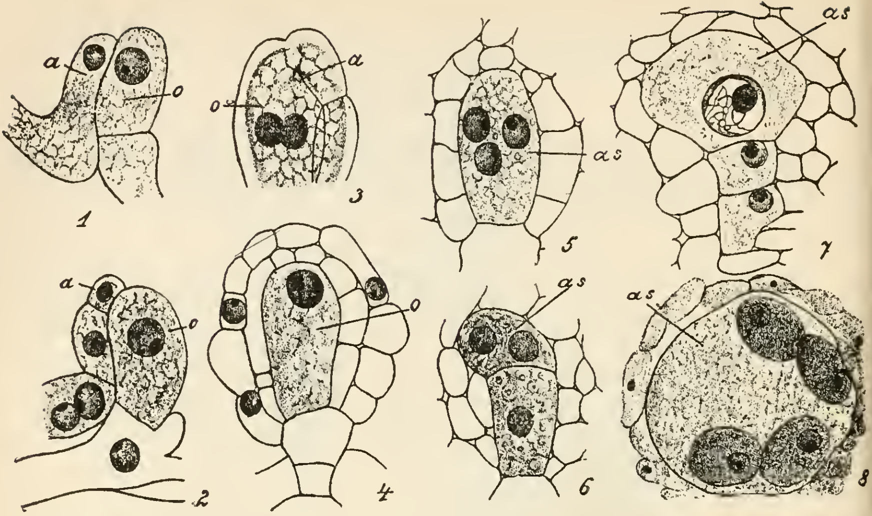

Fig. 92. Powdery Mildew. *Sphaerotheca Castagnei.* 1. Oogonium (*o*) and antheridium (*a*). 2. Separation of antheridium cell. 3. Fertilization and formation of additional cells. 5-8. Further development of cells. All greatly magnified. After Harper.

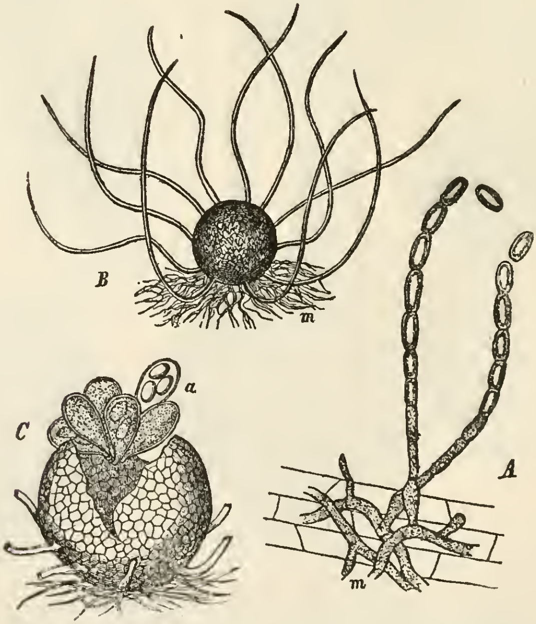

Fig. 93. Powdery Mildew of Grass (*Erysiphe graminis*). A. Oidium stage and mycelium *m*. B. Perithecium with appendages and mycelium *m*. C. Perithecium with asci and ascospores. After Frank.

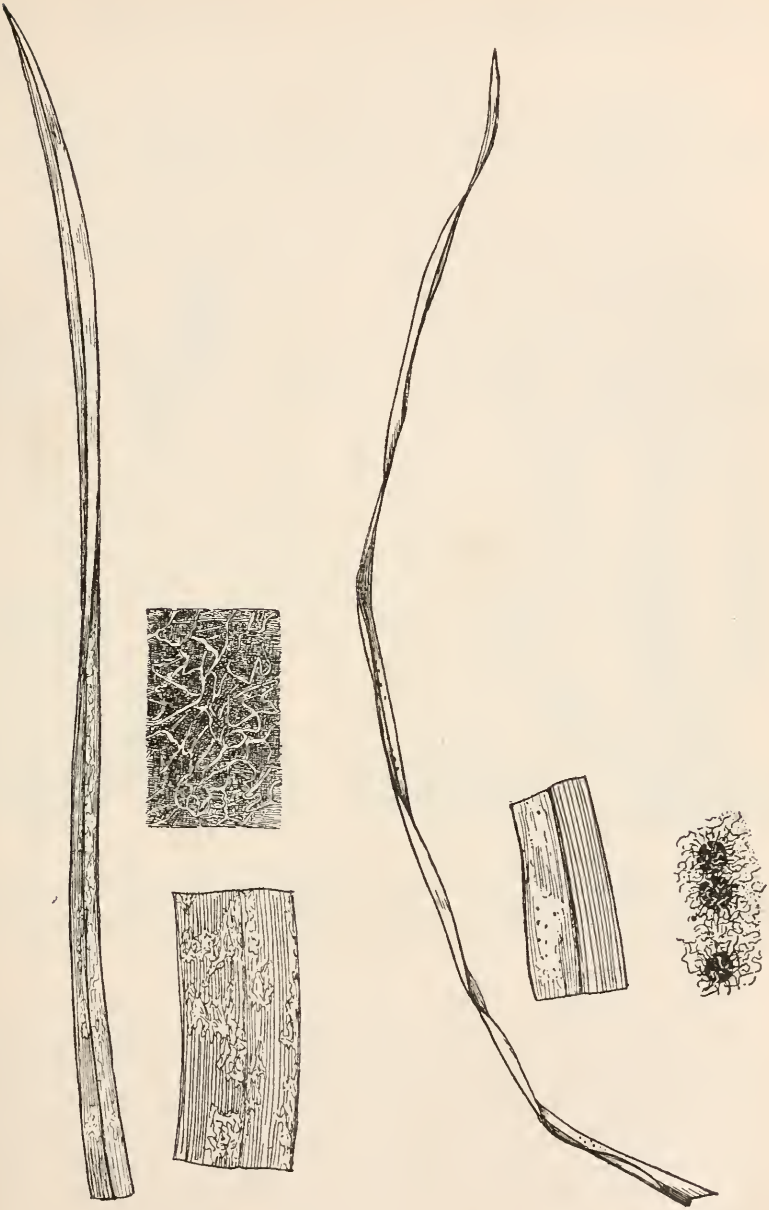

Fig. 94. Powdery Mildew of Bluegrass (*Erysiphe graminis*). Oidium stage; leaves at the right magnified, the one above more highly, showing the powdery substance. (Charlotte M. King).

Poisonous properties. The Veterinarians of Europe ascribe to these mildews a form of stomatitis.

Erysiphe graminis D C.

Amphigenous, often epiphyllous, mycelium dense, felt-like, persistent, white or gray, sometimes tinted brown; perithecium immersed in the mycelium, few and scattered, large, about 225 μ, in diameter; asci 16-25 μ oblong or oval, stalked, ascospores 8 or rarely 4; appendages rather short.

Distribution and Hosts. Found on many different grasses like blue grass (*Poa pratensis*), fowl meadow grass (*Poa serotina*), occasionally also on wheat or orchard grass. The following rather popular account treats of this disease as it is common in the west.

Every one who has had occasion to walk through a blue grass meadow after a rain, especially in damp and shaded places close to the ground, must have noticed a white mealy covering on the blades of many of the leaves. The Germans have called this mehlthau (literally translated meal dew), which is certainly very expressive of its appearance. An examination with a microscope will show that this white substance is composed of spores and a mycelium. The mycelium is cobwebby and spreads over the surface, but does not penetrate the leaf. In numerous places erect branches are produced, these bear numerous spores. This stage was formerly called *Oidium monilioides,* being named Oidium because the spores resemble an egg, although the resemblance is not marked in all cases of Oidium; the species was called *monilioides* because it was necklace like, referring to the manner in which the spores are borne. Worthington G. Smith states that the spores are so small that it would take about a million to cover a square inch.

In a powdery mildew occurring on the squirrel-tail grass, and supposed to be the same fungus, these spores are also capable of immediate germination. On blue grass the fungus frequently does not produce perithecia but ends its existence with the formation of conidia. It produces perithecia abundantly on wheat in Iowa.

These conidia or summer spores germinate, under favorable conditions, in from ten to sixteen hours. The temperature most favorable for germination is from 17-26° C. In a powdery mildew occurring on the squirrel-tail grass, and supposed to be the same fungus, these spores are also capable of immediate germination.

Under favorable conditions, especially moisture and damp weather, the fungus spreads rapidly. The leaf of grass affected by this fungus soon dries, and when the affected plants are disturbed, small clouds of dust arise, especially in shady places. The perfect stage of the fungus is not of common occurrence, though if careful search is made in the fall, small black specks may be seen; these are the perithecia and contain the asci and ascospores. It is the resting stage or winter condition of the fungus. The writer found the perfect fungus abundant on *Poa Wolfii* in Colorado, and Carver found it abundant on blue grass near Ames one season. The spores of the Oidium stage do not retain their power of germination very long, but the ascospores contained in the perithecium germinate the following spring, and when the tube comes in contact with the proper host the mycelium spreads over the surface of the leaf and causes the mealy appearance.

Poisonous properties. This species is abundant and often causes serious trouble; it certainly renders the hay nearly worthless to be fed to animals. It often, no doubt, gives rise to a stomatitis such as is described for other fungi.

HYPOCREALES

Perithecia spherical or ellipsoidal, with an ostiolum; stroma when present variously colored, reddish, yellow, never black or hard.

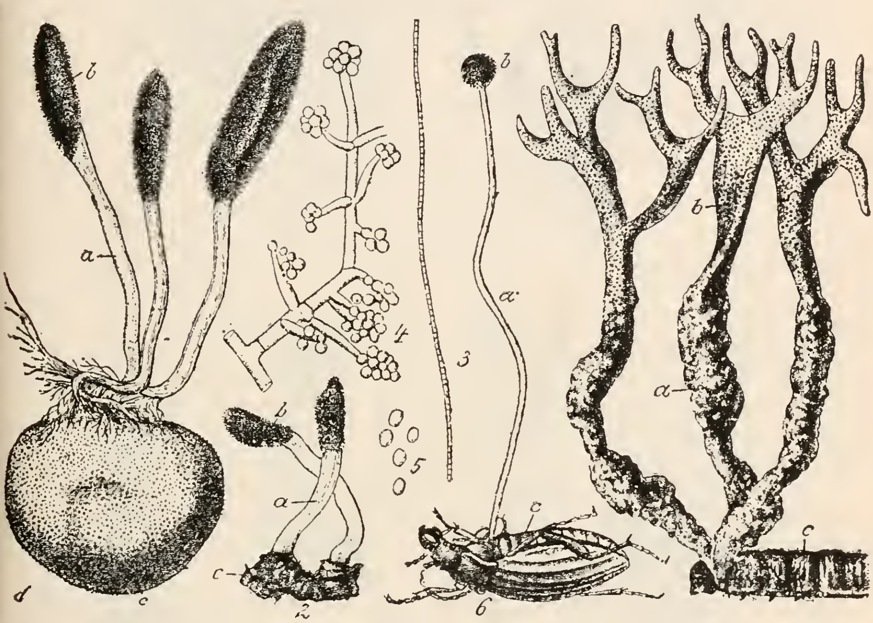

Fig. 95. Various species of *Cordyceps*. 1. *C. ophioglossoides*. 2. *C. militaris, a* Stroma on a caterpillar (*c*). 3. Stroma on a fruiting form of *Elaphomyces granulatus*. 3. Ascospore x 200. 4. Conidiophore x 350. 5. Conidia of *C. ophioglossoides*. 6. *C. cinerea* on a beetle (*c*). 7. *C. Taylori* on a caterpillar (*c*). *a* in all figures sterile, *b* fertile part of the Stroma. 1 and 6 after Lindau. 3-5 after Brefeld.

HYPOCREACEAE

Simple or compound; perithecia somewhat coriaceous, never black; bright colored, opening by a subcentral ostiolum, stroma soft, waxy, or occasionally cottony. A very numerous family containing many species. Contains the genera *Nectria*, of 250 species, some being parasitic upon trees; the *Gibberella* and the *Hypocrea* upon barks of trees, etc., *Cordyceps*, parasitic upon various insects, *C. militaris* being found upon Lepidotera, the conidial stage of which is *Isaria farinosa*, the *C. Ravenelii* upon the larvae of the June beetle; *Polystigma rubrum*, parasitic upon the plum; *Epichloe typhina*, the so-called Cat-tail fungus found upon various species of grass, especially timothy and orchard grass. Contains also the *Gibberella Saubinetii*, a parasite on wheat, which is a stage of *Fusarium roseum* described later in this work.

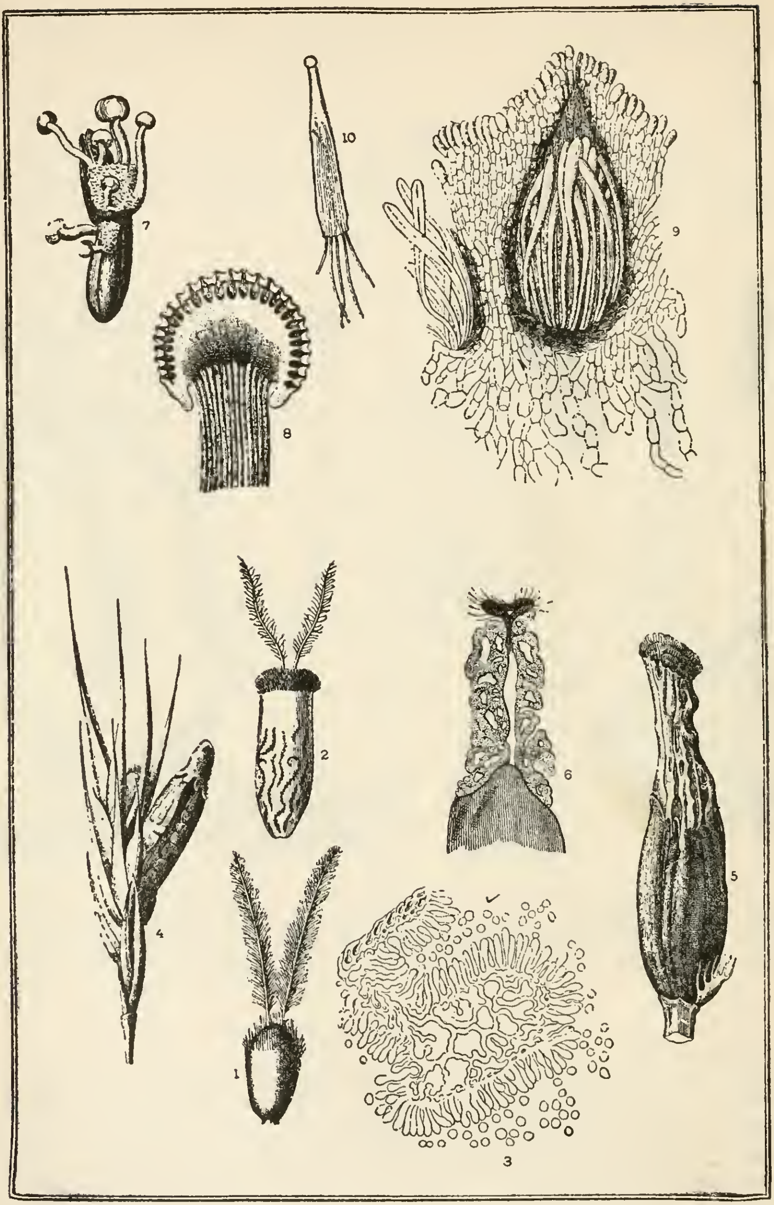

Fig. 96.—Normal ovary of rye. Fig. 2—Same invaded by Claviceps. Fig. 3—Cross-section of ovary showing mycelium and spores of sphacelial stage. The round bodies are summer spores. Fig. 4—Sclerotium stage. Fig. 5—Sclerotium stage. Fig. 6—General view in sphacelial stage. Fig. 7—Development of ergot in spring. Fig. 8—Cross-section of globular head showing flask shaped perithecia. Fig. 9—Asci. A single perithecium showing elongated bodies in the center. Fig. 10—A single ascus with filiform ascospores protruding. These spores (reproductive bodies) germinate and infect the young ovary of rye. After Tulasne. U. S. Dept. Agrl.

Claviceps, Tul. Ergot.

Stroma erect, consisting of a sterile stem; subglobose, fertile head from a subcylindrical, black, hard sclerotium; perithecium immersed in the stroma, flask shaped; asci, clavate-cylindrical; ascospores, filiform, colorless.

Claviceps purpurea, (Fr.) Tul.

Sclerotium variable in length from ⅛ to 1 inch long or more; long cylindrical; generally somewhat curved, wrinkled, purplish on the outside, white within; usually several fruiting bodies from the same sclerotium; heads spherical, tuberculose, borne on short flexuose stems; asci narrow, linear, 8-spored, ascospores filiform, continuous, attenuated toward the end, 50-76 μ long.

Ergot is a stage of a minute parasitic fungus; although its true nature was not known by early writers, it is mentioned by many of them. Lonicer, about the middle of the sixteenth century, mentions its specific use. Thalius applied the name of "ad sistendum sanguineum."

Bauhin used the name of *Secale luxurians.* De Candolle called it *Sclerotium clavus.* Although other names have been applied to it, the credit of working out the life history belongs to Tulasne, one of the most eminent of French mycologists.

There are still many persons who believe that ergot is a degenerate kernel of rye or wheat, but the researches of Tulasne and other mycologists have laid at rest many of the vague theories concerning it. The black, purple, or dark gray spurs found in the flowers of rye, wheat, and other grasses are simply one stage of a parasitic fungus, known as *Claviceps purpurea.* These spurs consist of a compact mass of threads known as the sclerotium stage; it was formerly called *Sclerotium clavus.*

No changes occur in ergot while it remains in the head, but the following spring, when laid on damp earth, it produces at different points small, roundish patches which are somewhat elevated. Soon a small white head appears which elongates, becoming stalked, and bearing a globular head at the tip. These heads change from a grayish yellow to a pinkish color. A cross section shows that the central portion is made up of closely woven hyphae or fungus threads, while the edge contains a number of flask-shaped bodies, the perithecia, in which are found elongated bodies known as asci; each ascus contains eight filiform spores, the ascospores. The ascospores germinate and when coming in contact with a very young ovary the mycelium penetrates the delicate walls of the ovary and gradually displaces it. It is quite-easy to trace out its life history by placing the ergot in damp sand and allowing it to remain over winter.

The first indication of ergot in the summer is the formation of the so-called honey-dew, a sweetish and rather disagreeable fluid, which is eagerly sought by flies and other insects which feed upon it. This fluid contains a large number of small spores so that insects can readily carry the fungus from a diseased ovary to one not diseased. These spores germinate immediately. This stage is called the sphacelia, and formerly was held to be a distinct fungus. In this stage the mass which has replaced the ovary is soft, but as it becomes older it hardens; ultimately a hard and compact mass, the ergot, is formed.

Distribution and hosts. Found on a large number of host plants. Rye is more subject to it than any of the other cultivated cereals. The largest specimens are usually produced on isolated specimens of rye coming up in fields. It seldon happens that all of the ovaries are affected. Wheat, especially winter wheat, is subject to the disease. The officinal ergot is usually obtained from rye. In Europe it has been reported on oats. Mr. C. W. Warburton found it on the same host in Iowa, in 1909.

Of our native wild grasses, wild ryes (*Elymus robustus, E. virginicus, E. striatus, E. canadensis, Asprella hystrix*) are most subject to the disease. Most cases of ergotism in the United States undoubtedly result from the ergot on various species of Elymus; in Iowa on the *Elymus robustus*, which is a common plant everywhere. *Agropryon occidentale*, a grass not uncommon in northwestern Iowa, and Quack Grass (*Agropyron repens*), are also much subject to its attacks. Scarcely a head of the Western Wheat Grass cultivated on the college farm could be found which did not have some ergot. This may be for the same reason that it occurs most abundantly on rye, namely, that the grasses occurred in isolated places. In some pastures, timothy (*Phleum pratense*), is much subject to the attack of *Claviceps purpurea*. Thus in an old pasture in Wisconsin I observed a large percentage of timothy which contained many heads which were ergotized. Blue grass (*Poa pratensis*), *Poa annua, Calamagrostis canadensis, Agrostis alba, Glyceria fluitans,* and many others, in some seasons and localities, are diseased. Unusually large spemimens sometimes occur on Wild Rice (*Zizania*) in Iowa.

It may be possible that some of the forms of ergot on grass may be referred to other species. Halsted states, however, that ergot on *Elymus robustus* is *Claviceps purpurea*. The *Hordeum jubatum* contained apparently the same species, with some minor differences but these were due to the nature of the host. *Claviceps microcephala* (Wallr.) Tul., occurs on *Phragmites, C. setulosa* (Quel.) Sacc. with yellow stroma on *Poa,* and *C. pusilla* *Ces* on *Andropogon Ischaemum.*

Poisonous properties. The subject of ergot and ergotism is one of considerable importance to stockmen in many parts of the country. Scarcely a year passes without some complaints being received by the state veterinarians of the injurious effects of ergot. The writer receives several complaints of this kind every year. But the cases of ergotism today are not nearly so frequent as they were 40 or 50 years ago. We will, therefore, append here a short history of the disease.

Epidemics of ergotism have, without doubt, been correctly referred, before the tenth century. Wood states that epidemics of ergotism or chronic ergot poisoning have been recorded from time to time since the days of Galen (130-200 A. D.) and of Caesar (B. C. 190-44). From the ninth to the thirteenth ceutnry epidemics were frequent in France, and in the twelfth in Spain. They were first called plagues but later received special names. In 1596 Hesse and adjoining provinces were visited by this plague which was attributed to the presence of ergot in grain. In the epidemic in Silesia in 1722, the king of Prussia ordered an exchange of sound rye for the affected grain. Freiburg was visited in 1702, Switzerland in 1715-16, Saxony in 1716, and other districts of Germany in 1717, 1736, 1741-42. France was visited in 1650, 1670, and 1674. From 1765 to 1769 it was abundant in Sweden in rye and barley. Linnaeus attributed it to the grain of *Raphanus raphanistrum,* which occurred in France in 1816, in Lorraine and Burgundy; it was especially fatal to the poorer inhabitants.

It has been observed that these epidemics follow a rainy season. Fleming states that in 1041, when the weather was so unpropitious, tempests, rains, and inundations occurring, many cattle perished from the disease. "In 1098, after inundations and heavy fogs, there was a general epizootic among cattle in Germany. In the same year ergotism appeared in the human species."

Dr. Randall, in 1849, called attention to a disease in New York, in which the involved parts were finally invariably affected with dry gangrene. He states that in the severe climate of New York farmers allow their cattle to winter in fields on blue grass (*Poa pratensis*) which is rich in ergot. A disease known as "hoof-ail" was correctly ascribed to ergot by James Mease, of Philadelphia, prior to 1838. The disease was quite severe in Orange county, New York, in 1820. It was minutely described by Arnell. In 1857, the disease was quite severe in Portage county, Ohio. A committee appointed by the Farmers' Association of Edinburg reported that the disease was due to ergot contained in the hay eaten by cattle. In recent years, epizootics of ergotism have been reported by Law in New York, Stalker in Iowa, and Faville in Colorado. In 1884, a very serious outbreak occurred in Kansas which was at first diagnosed as "foot-and-mouth disease." Dr. Salmon found, upon examining samples of hay from various localities in the state, that these contained considerable quantities of wild rye (*Elymus virginicus, var. submuticus*) which in turn contained a large amount of ergot, in one case, 12 per cent and in another 10 per cent being found. From this he estimated that 5-6 per cent of the entire weight of the plant must have been ergot and that a twenty-pound ration of hay would contain four ounces of ergot.

Dr. Harshberger has called attention to an outbreak of ergotism from the use of ergotized red top, the fungus being common on red top throughout the United States and being one of the most common impurities in red top seed.

The ergot contains the substance leucin and the non-nitrogenous substance ergotine, which according to the earlier investigations was regarded as the active principle and as an alkaloid. According to Wenzell ergot contains the two alkaloids, *ecbolin* and *ergotin* $C_{50}H_{52}N_2O_3$ an amorphous, alkaline, feebly bitter substance. But according to the later investigations these substances are identical. Tanret isolated the crystallizable alkaloid *ergotinin* $C_{35}H_{40}N_4O_6$; this is a crystalline, slightly bitter substance, subsequently Kobert found that this substance would not produce the action accredited to it and attributed its action to *ergotinic acid* and the alkaloid *cornutin.* The more recent investigation of Jacobi attributes the poisonous action to *chrysotoxin,* an amorphous glucosidal acid. *Secalinotoxin* is a compound of *sphacelotoxin,* and *secalin* $C_{29}H_{55}N_6O_4$; accompanied by the harmless substance, *ergochrysin.* According to Kobert *cornutin* is an alkaloid having a specific action on the uterus, causing it to contract; sphacelic acid, a non-crystallizable and non-nitrogenous substance which causes the poisoning and gangrene; ergotinic acid, a nitrogenous glucoside without action on the uterus and narcotic in its effects. Besides these substances it contains others, prominent among them being a sugar called mycose, which is also present in other fungi. Ergot stimulates the involuntary muscles of the stomach and the intestines, it causes a constriction of the arterioles and veins throughout the body with an increase of blood pressure. In toxic doses it paralyzes both the vasomotor centers and the heart muscle.

It appears from the experiments of Dale[1] and Barger and Carr[2] that *cornutin* does not occur as such in ergot but is an artificial decomposition. Tanret discovered the first well defined crystalline alkaloid which he called *ergotinin.* The *secalin* of Jacobi[3] is identical with ergotinin. Barger and Carr separate a second alkaloid which can be recognized chemically; to this they gave the name of *ergotoxin,* $C_{35}H_{41}O_6N_5$. This substance is of great physiological potency. According to Dale[4] ergotoxin produces in doses of a few milligrams "not only the characteristic reaction of ergot described by him, but also gangrene of the Cock's-comb, and other ergot effects described by Kobert and others to *sphacelic* acid."

According to Cronyn and Henderson[5] *ergotoxin* is a highly active alkaloid and has the properties of ergot most desired in medicine. It brings on long enduring vaso-constriction, increases uterine movements when injected intravenously and the same to a less extent when injected subcutaneously, but when given per os has very little action.

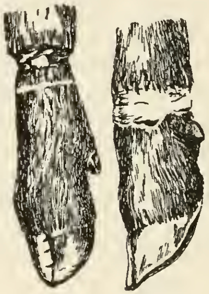

Fig. 98.—Effects of Ergotism: Hoofs of cattle showing flesh sloughing away. (Salmon.)

The toxicology of ergot is well described by Dr. Winslow as follows:

> Enormous single doses are required to poison animals or man. When as much as two drachms of ergot to the pound, live weight, are given to dogs, death is not constant. Three ounces, however, have proved fatal to small dogs. Acute poisoning is characterized by vomiting (in dogs), profuse salivation, dilation of the pupils, rapid breathing and frequent pulse. The animal cries out, has convulsive twitchings, staggering gait, paraplegia, intense thirst, and coma, terminating in death. Horses, cattle, and sheep are unaffected by any ordinary quantity of the drug.
>
> Chronic poisoning or ergotism rarely occurs in animals owing to continuous ingestion of ergotized grains. It is characterized by gastro-intestinal indigestion, with nausea, vomiting, colic, diarrhoea or constipation, and abortion ensues in pregnant animals. In addition to gastro-intestinal irritation the symptoms naturally assume two forms: 1. The gangrenous form; 2. the spasmodic form. In the first variety of ergotism there are coldness and anesthesia of the extremities, including the feet, ears, and tail of quadrupeds; the comb, tongue, and beak of birds, — followed by the appearance of passive congestion, blebs, and dry gangrene in the vicinity of these parts. The hoofs and beaks often drop off.

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[1] Jour. Phys. 34:163, 1906.

[2] The alkaloids of Ergot. Jour. Chem. Soc. 91:337, 1907. These writers give a full literature on the subject.

[3] Arch. Expt. Path. Par 39:104.

[4] Jour. Phys. 34:163.

[5] Jour. Pharma. and Expt. Therapeutics. Aug. 1909.

Death ensues from general exhaustion. In the spasmodic form are seen tonic contraction of the flexor tendons of the limbs and anaesthesia of the extremities; muscular trembling and general tetanic spasm, with opisthotonos, convulsions and delirium. Death also occurs from asthenia.

Grünfeld fed various animals with sphacelic acid in food. In the cocks, gangrene soon appeared affecting the comb; next the wattles, tongue linings, and crop. In hogs, the ears became gangrenous and fell off. Horses and cows fed upon grains containing ergot lose their hoofs, ears, and tails. The cornutin, according to Kobert, acts through the nerve centers. Microscopic examination of the abdominal and thoracic regions shows a toxic polyneuritis.

Dr. McNeil in describing the disease says:

> Ergot stimulates the nerve centers that cause the contraction of the small blood vessels supplying the different parts of the body and cause one of the two forms of ergotism, namely, a nervous form, and a gangrenous form.
>
> Nervous Ergotism: In this form the contraction of the blood vessels of the brain produces dullness and depression. The animal also suffers from gastro-intestinal catarrh, refuses food, and gradually passes into a condition of general wasting. The nervous form, however, may assume an entirely different aspect and the animal dies suddenly in delirium or spasms, or gradually from paralysis.
>
> Gangrenous Ergotism: In this common form the checking of the blood, resulting from the contraction of the small blood vessels, causes a loss of a part or of all the limb below the knee or hock, the tail, or the ears. This form of the disease may manifest itself by the formation of ulcers at the top of the hoof or between the toes, and a toe may be lost or the entire hoof shed. The affected part dries, a small furrow or line of separation appears, completely surrounding the limb, dividing the living from the dead mummified tissue.

DOTHIDEALES

Perithecia reduced, asci arising from the stroma and not separable from it, stroma present, not fleshy; black or dark colored ostiolum present.

DOTHIDEACEAE

Stroma pulvinate, elongated, black or nearly black, coriaceous; perithecia inseparable from the stroma, asci 4-8 spored; hyaline, yellowish or brown.

Phyllachora, Nitschke.

Stroma variable, elliptical, oblong or lanceolate, covered by the epidermis, black, roughened, ascospores ovate, elliptical, or oblong, mostly hyaline. About 200 species.

Phyllachora Trifolii, (Pers.) Fckl.

Stroma on the lower surface of the leaf, gregarious, collected in small, elongated groups extending along the nerves of the leaf, black, subglobose, prominent, often confluent; ascospores elliptical, hyaline, continuous, 10-20 μ In the early part of the season small whitish or pale brown spots appear on the leaf, which contains the mycelium of the fungus. Dr. Trelease says:

> This fruits on the lower surface, producing numerous tufts of necklace-shaped threads, each of which ends in a 2-celled, egg-shaped conidia-spore. These tufts of threads, which, like the spores, are of a deep brown color, are packed so closely together as to completely cover the spots, though under a hand lens they can be distinguished as separate panules. To the naked eye they appear dead-black. Later in the season similar spots are occupied by small, coal-black fruits that contain stylospores. Winter spores, produced in asci, are not known. The conidial form of this fungus is especially common on white clover, though both forms are at times found abundantly on red clover and other species.

The *Polythrincium* is common on red clover and is one of the numerous species which may be injurious to cattle.

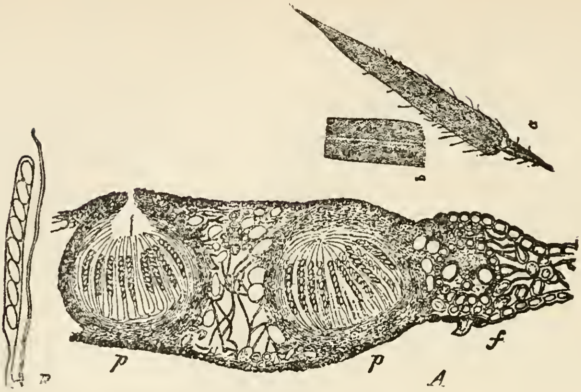


Fig. 99. Black Spot of Grasses (*Phyllachora graminis*). A. Cross section of leaf through a black mass of the fungus. *P.* Perithecia. B. An ascus with ascospores. a, b. Spots on grass leaf caused by the fungus. After Frank and Trelease.

Phyllachora graminis (Pers.) Fckl.

Stroma scattered or confluent, penetrating the leaf and more or less prominent on both sides, covered by a black and shining epidermis, roughened; ostiola obscure; asci short, stalked, cylindrical, 75-80 x 7-8 μ, ascospores 8, paraphyses present.

Phyllachora graminis, occurs on many cultivated and wild grasses; other species occur on clover and other leguminous plants. This parasitic fungus disease causes blackish spots on the lower or both surfaces of the leaf. The fungus causing these black spots on grasses has been called the black spot disease.

During August, and especially later, the coal black spots along the veins are especially prominent; they are considerably less than one-eighth of an inch in length and width and occur on both surfaces of the leaf, but are more abundant on the upper. These black spots are composed of dense mycelium, which in the green leaves bears numerous small spores which serve to progapate the fungus in the summer. In dead leaves, small perithecia are found, which contain numerous elongated bodies, the asci, within which are found eight small, colorless spores, known as ascospores; these latter carry the fungus over winter.

Distribution and Hosts. Widely distributed in both Europe and North America, very common upon Quack Grass, Wild Rye, Bottle Grass, Panic Grass, etc.

Poisonous properties. The genus Phyllachora is abundant at times and is associated with stomatitis.

SPHAERIALES

Perithecia generally with a distinct ostiolum, of various consistency, not reddish or membranous, brown or blackish; stroma when present dark colored outside and whitish within. Contains the families: *Sordariaceae*, found upon decaying plants and substances; *Chaetomiaceae*, with superficial perithecia, generally with short ostiolum and an apical tuft of hairs or bristles; one species *Chaetomium chartarum* common on paper. *Sphaeriaceae,* with membranaceous perithecia, apex perforated with a simple pore, contains a large number of parasitic fungi like the strawberry rust or spot disease (*Sphaerella Fragariae*), and the spot disease of the currant (*Cercospora angulata*).

FUNGI IMPERFECTI

The fungi included in this group are simply form genera, many of the species belong to the *Pyrenomycetes,* some belong to the *Phychomycetes,* and some to *Hymenomycetes.* In this connection we shall describe a few only which may cause trouble in forage.

Helminthosporium gramineum, Rabh. Yellow Leaf Disease of Barley

Spots in parallel rows, causing the leaves to become marked with yellow lines of pale green color; mycelium of the tissue colorless; conidiophores brownish on the surface, spores large 3-6-celled.

Distribution. Widely distributed in Europe and North America on barley.

Helminthosporium turcicum, Pass. Leaf Browning of corn

Spots sharply limited, conidiophores brownish elongated, bearing several brown spores. Widely distributed in Europe on corn, and also in North America.

Helminthosporium inconspicuum, E. & E.

Leaves dead and discolored, discoloration sometimes interrupted by spots of various sizes; conidiophores brown with several-celled conidia.

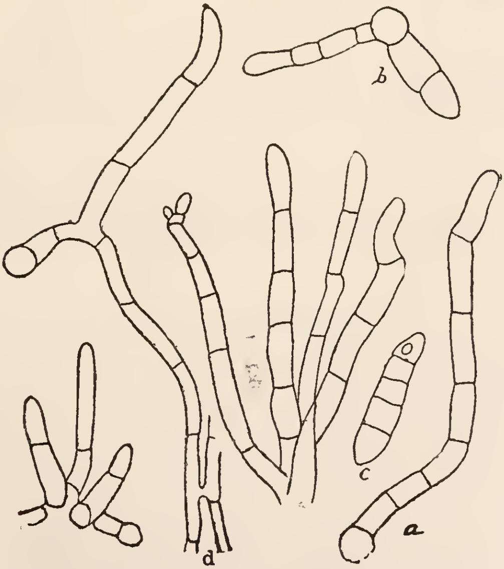


Fig. 100. Yellow Leaf Disease of Barley (*Helminthosporium gramineum*). a. Hypha arising from short cells. C. Conidium and to the left a cluster of conidiophores. d. Mycelium.

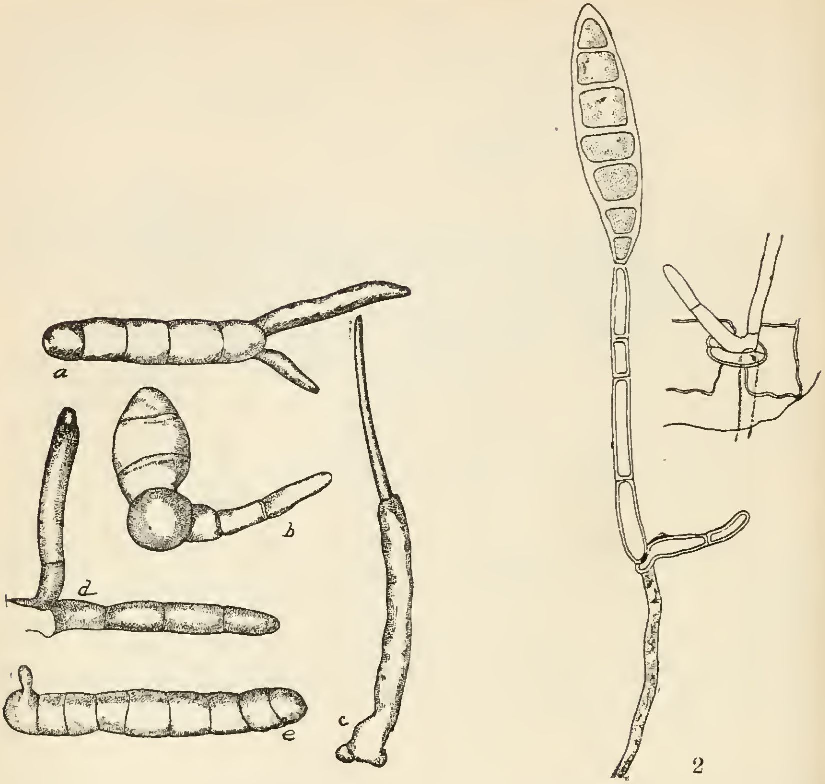


Fig. 101. Spores of Yellow Leaf Disease of Barley (*Helminthosporium gramineum*). a. and e. Spores germinating. d. Conidiophore. 2. Leaf browning of Corn (*Helminthosporum turcicum*). Spore and conidiophore to the left. To the right, conidiophore pushing through stoma.

Distribution and hosts. On corn, widely distributed in North America.

Poisonous properties. All of these fungi may be regarded as injurious, possibly producing stomatitis.

Scolecotrichum graminis, Fuckel

Elongated brown or purplish-brown spots, the centers of which are gray or whitish and contain minute black dots; these small dark spots contain the tufts of brown fungus threads, which make their way out through the stomata; the hyphae are somtimes septate and the spores are usually borne at the end or occasionally in a lateral position; these fruiting hyphae bear small, smoky-brown, two-celled spores; the cells of the leaf become much altered, because the colorless threads of the fungus permeate them. On barley the disease is marked by brown or purplish-brown spots which appear on the leaf transversely.

Distribution. Widely distributed in Europe and North America.

Poisonous properties. May possibly produce mycotic stomatitis.

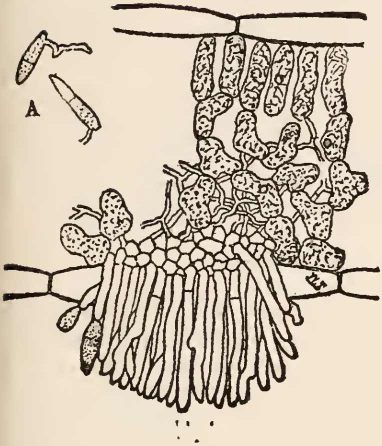
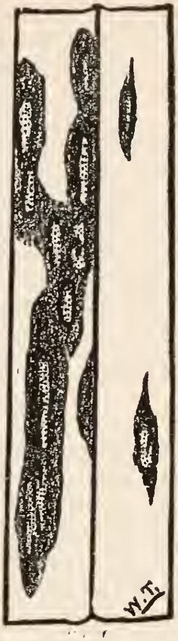


Fig. 101a. Spot Disease of Orchard Grass (*Scolectotrichum graminis*). Cross-section of leaf, general fruiting layer of fungus with conidiophores and conidia. A, spores germinating. After Trelease.



General appearance of fungus on leaf of Orchard grass. After Trelease.

Polydesmus Mont. Rape Fungus

Sterile hyphae repent; fertile erect, simple or branched septate colorless conidia, interstitial filiform, concatenate, fusiform or clavate; many septate and opaque.

Polydesmus exitiosus Kühn. Rape Fungus

Forming minute, punctate, elongated dark brown spots, conidia elongated or somewhat clavate, narrowed upwardly, 18-12 septate; the septa but slightly constricted, olive-brown in color. The conidia are 120-140 by 14-16 μ; conidiophores short, straight or slightly irregular, septate, making their way through the stomata.

This fungus is widely distributed on rape and cabbage and has been referred to as *Alternaria brassicae.* It is, however, thought to be a distinct fungus.

Poisonous properties. In Europe this fungus has long been associated with mycotic-stomatitis of cattle, but mycotic-stomatitis may be produced as indicated elsewhere, by other molds and fungi. This disease is characterized by inflammation and ulceration of the mucous membranes of the mouth. Salivation is a prominent symptom; the feet become swollen and sore. Dr. Mohler says:

> "Superficial erosions of the skin, particularly of the muzzle, and of the teats and udders of cows, may also be present, with some elevation of temperature and emanciation."

The disease is not serious and in many cases recovery occurs. But where treatment is not resorted to the disease may prove fatal, death occurring in from 6-8 days. Dr. Mohler states that in serious outbreaks it is about 0.5%.

The treatment should consist of first removing the herd from the infected pasture or inclosure containing the fungus. They should be fed on good wholesome soft nutritious food, plenty of cold water should be given. Dr. Mohler recommends dissolving 2 heaping tablespoonfuls of borax or 1 tablespoonful of potassium chlorate in each of the first two buckets of water taken during the day. If the animals permit the mouth should be swabbed out with some antiseptic wash, such as weak carbolic acid or creolin solution, or permanganate of potash, or hydrogen peroxid. Mohler recommends that range cattle can be treated by the use of medicated salt.

> "This salt may be prepared by pouring 4 ounces of crude carbolic acid upon 12 quarts of ordinary barrel salt, after which they are thoroughly mixed. The lesions of the feet should be treated with a 2 per cent solution of carbolic acid or of creolin, while the fissures and other lesions of the skin will be benefited by the application of carbolized vaseline or zinc ointment. If the animals are treated in this manner and carefully fed the disease will rapidly disappear."

Cladosporium herbarum (Pers.) Link

This fungus and its allies are very common upon oats, sometimes very destructive. It attacks all parts of the plant, but is especially common in the heads. The mycelium of the fungus grows not only on the surface of the plant but also in the interior; the conidiophores and spores are olive green, the former pass through the opening of the stomata or break through the epidermis; the spores are 1- to 2-celled, borne on the end or on short lateral branches and are extremely variable in shape and size.

The general effect of the disease is to cause the kernels to shrivel. The disease, as recorded by Cobb, occurs rather destructively on oats. Professor Peck records the occurrence of a Cladosporium on oats, which he describes as a new species, the *Fusicladium destruens.* He says in regard to oats:

"The foliage of the plants presented a singular admixture of green, dead-brown and reddish hues, strongly suggestive of that of a 'rust-struck' field."

Peck thinks this fungus inhabits the leaves of some of our northern grasses and has escaped from them to oat fields. Giltay reports that plants are infected in the same way as in some of the grain smuts, the spores being carried over with the seed, and that the disease can be prevented by treatment with hot water. A species of Cladosporium commonly affects the kernels of maize and is at times quite troublesome.

Septoria Fr.

Perithecia imbedded in the tissues of the plant, appearing as small blackish or brownish spots; conidia generally multicellular and colorless; produced from short conidiophores. A genus containing numerous species of wide distribution. Many of them like the Septoria on the black currant and gooseberry, and the blackberry leaf spot, *Septoria rubi,* are troublesome parasitic fungi of cultivated plants. All of these fungi irritate the mucous membranes when found in abundance in the leaf.

Septoria graminum, Dem.

Spots at first yellow, then reddish-brown and finally whitish; perithecia blackish or brownish-black; spores 50 to 60 μ long and 1.5 to 2 μ wide, numerous, usually 2-celled.

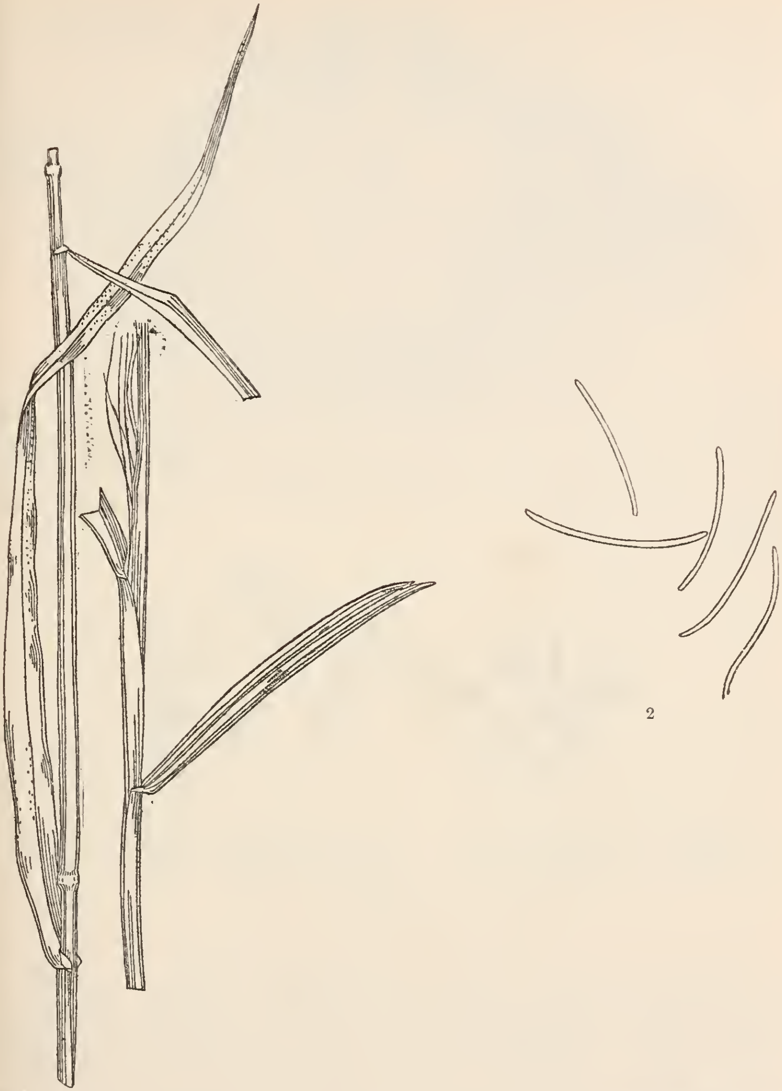


Fig. 102. 1. Leaf of Cheat, showing numerous small specks, the perithecia of *Septoria Bromi*, the spores in the perithecia shown at 2.

In a somewhat extended account of this disease Cobb states that the entire plant is not always involved. The fungus is variable, its character depending upon the host which it attacks. On *Poa annua* the leaf is mainly involved and in many cases is totally destroyed. Cavara states that the spots on the leaves are small, elliptical, red or yellow, or the latter may be entirely absent. The injury it does to young plants is very great; in some cases their total destruction has been observed.

Janczewski who has studied the life history of *Septoria graminum* states that this represents the pycnidial stage of *Leptosphaeria tritici* and that the conidial form is the *Cladosporium herbarum.* We have not found the *Septoria* in Iowa though the *Cladosporium* is common.

The *Septoria tritici* Desm. is closely related to the above and should perhaps be regarded as nothing more than a variable form of *S. graminum.* The spots it produces are at first yellow, then reddish-brown, and finally whitish. The spores are 50-60 μ long and 1-5 to 2 μ wide and usually divided. A *Septoria* on the glumes of wheat in Ohio has been reported by Selby.

Several other species of *Septoria* are allied to the above species, one, the *Septoria bromi* Sacc. is common in Iowa on *Bromus secalinus.*

Diplodia, Fr.

Perithecia bursting out sub-cutaneously, sub-carbonaceous, papillate according to type; spores ellipsoidal, ovoid or oblong, 1-celled, fuscous, perforated; basidia rod-like, simple hyaline. From the original genus have been separated five genera as follows: Species with superficial perithecia *Diplodiella;* with hirsute perithecia *Chaetodiplodia;* with clustered perithecia *Botryodiplodia;* with mucilaginous spores *Macrodiplodia;* with hyaline spores *Diplodina.*

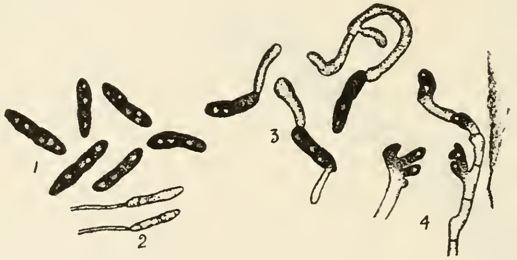


Fig. 103. Spores of *Diplodia* Zeae. 2. Young spores on the conidiophores with sporophores attached. 3. Germinating spores. 4. Dark swollen hyphae of Diplodia.

Diplodia Zeae (Schw.) Lév.

Pycnidia black and spherical to pyriform, those forming on the husk or stalk developing within the tissues and breaking through at maturity, the greater number of pycnidia, however, occur between the kernels and are situated in a stroma. Conidia dark brown, cylindrical to elliptical, obtuse, straight or usually slightly curved and 1-septate; one to several oil drops in each cell; 5μ in diameter; spores germinate in 18-24 hours in 3 per cent glucose agar at 26° C; in somewhat longer time when grown on corn agar; germ tube arises from near distal end at each spore.*

Distribution. A serious parasitic disease generally found where corn is cultivated, particularly in Illinois,* Iowa, and Nebraska.

Poisonous properties. This fungus is widely distributed in ears of corn and may be responsible for forage poisoning.

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* Heald, F. D.; Wilcox, E. M.; and Pool, V. W. The Life-history and Parasitism of Diplodia Zeae (Schw.) Lév.

* Burrill, T. J., and Barrett, J. T. Ear Rots of Corn. Bull. Ill. Agr. Exp. Sta. 133:65-109. *11 pl.*

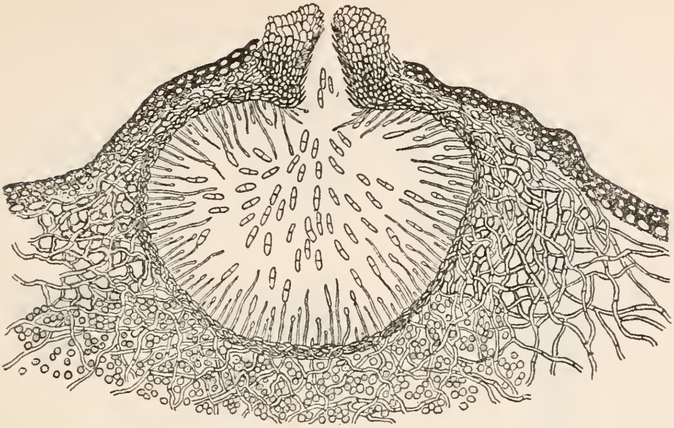

Fig. 103A. Cross-section of the pycnidium of *Diplodia Zeae* on a corn kernel showing sporophores, conidia and mycelium. After Burrill and Barrett.

Although the fungus has been cultivated, the toxic substance has not been isolated. The writer fed mouldy corn meal to cats and rabbits. It produced injurious effects in kittens; three of these animals fed with mouldy corn meal and milk died from the effects. Unfortunately, in this case, different moulds, *Aspergillus glaucus*, *Fusarium*, and *Diplodia*, were used.

Dr. Erwin F. Smith and Florence Hedges write as follows of this fungus:

> "It is also worthy of inquiry whether this fungus may not be the cause of the so-called 'cornstalk disease' prevalent among cattle in the west. It is also possible that to *Diplodia* should be referred the great numbers of deaths of negroes in the south during past three years (1906-1909) from the so-called pellagra, following the consumption of mouldy corn-meal and mouldy hominy. This fungus is also the cause of mouldy corn in Italy. The only other fungi we have reason for suspecting in this connection are species of *Aspergillus*." *

There are striking similarities between the so-called forage poisoning of cattle and the Pellagra disease in Italy and they are probably referable to some of the fungi found in corn. Dr. Miquel * in 1838 suggested that a Mucor was the cause of Pellagra.

Fusarium, Lk.

Mycelium spreading, more or less effuse; conidia spindle-shaped or sickle-like, many-celled at maturity, conidiophores branching, conidia borne at the apex. A genus of numerous species, many of which are of uncertain affinity, usually found on dead organic matter but several are known to produce diseases of cultivated plants, like *F. Lycopersici*, Sacc., which produces the "Sleeping Disease" of tomatoes, the mycelium occurring in the vessels of the roots and causing a wilting. The *Fusarium limonis*, Briosi, produces a mal-di-gomma, or foot-rot, of orange and lemon trees. The *Fusarium vasinfectum*, Atks., produces a disease of cotton, known as "frenching." The cotton wilt is caused by a species of *Fusarium* and the perfect form of this fungus according to E. F. Smith is *Necosmospora*.

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* Diplodia Disease of Maize (Suspected cause of Pellagra). Science 30:60-61.

* Die Noord—Nederlandsche vergiftige Gewassen. 43 Amsterdam 1839.

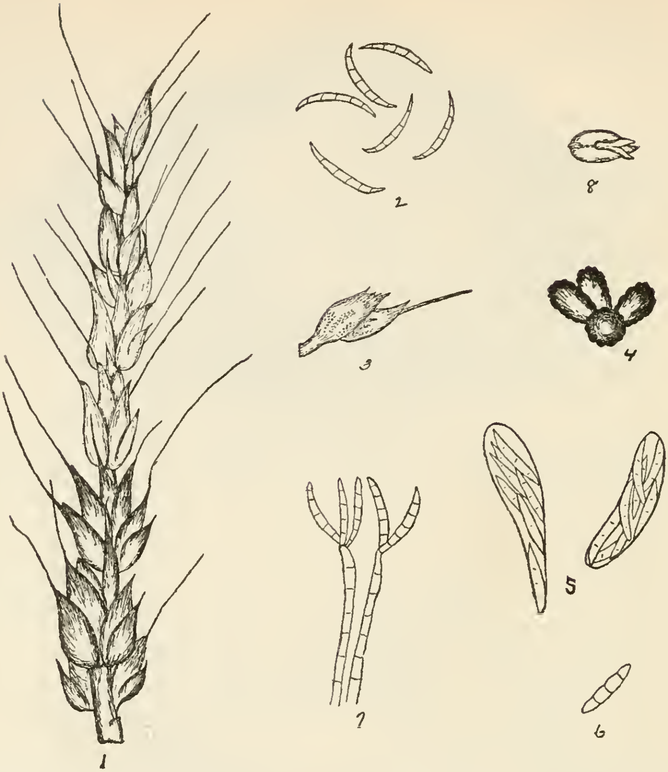

Fig. 104. Wheat Scab (*Gibberella Saubinetii*), perfect form of *Fusarium roseum* I. 1. Wheat affected with wheat scab, upper portion destroyed. 2. Glumes covered with perithecia. 4. Perithecia. 5. Asci from perithecia with ascospores, one of these enlarged at 6. 7. Conidiophore and spores grown in agar. After Selby.

Fusarium roseum, Link

Mycelium whitish or varying from yellow to orange, appearing at the time when the grain begins to turn; the head, or part of it, has a whitish appearance and the chaff is glued together; conidiophores branched, spores terminal or lateral, crescent shaped at first, 1-celled, finally 2 or more celled; color of the conidia white or in masses orange or pink. According to Saccardo the ascigerous stage is the *Gibberella Saubinettii* (*Mont.*) *Sacc.* with gregarious perithecia, coriaceous, or somewhat membranaceous; somewhat blackish in color, asci oblong, lanceolate, ascospores fusiform, 3-celled. Definite cultural experiments have not been made in this country to determine the relation of this fungus to the *F. heterosporum.*

According to Burrill and Barrett[*] several forms of Fusarium occur on corn. Saccardo in a letter to the writer identified the common Iowa Fusarium on corn as *F. heterosporum.*

The *Fusarium heterosporum* Nees, is common in parts of Germany, and Tubeuf quotes Frank as stating that the destruction of rye is total in some

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[*] Bull. Ill. Agrl. Exp. Sta. 133.

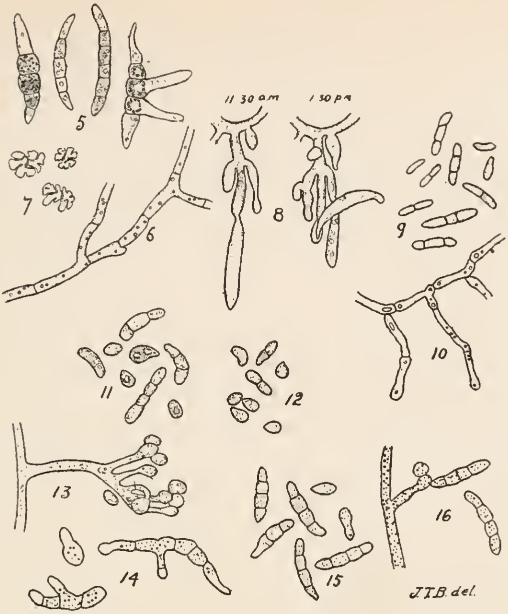

Fig. 105. Fusarium. 5. Macroconidia of Fusarium with the felty mass of mycelium. Produces a deep pink color. 6. Mycelium. 7. Corroded starch grains. 8. Conidiophores or sporophores. 9. Microconidia and macroconidia of another corn *Fusarium* frequently infecting isolated grains. 10. Mycelium of the same. 11. Microconidia and macroconidia of another *Fusarium* on corn, which produces a dense felty mass extending between the kernels to the cob. 13. A spore producing hyphae in prune juice culture. 14. Germinating spores of one of the species. 16. Hyphal branches of the same, with microconidia and macroconidia. After Burrill and Barrett.

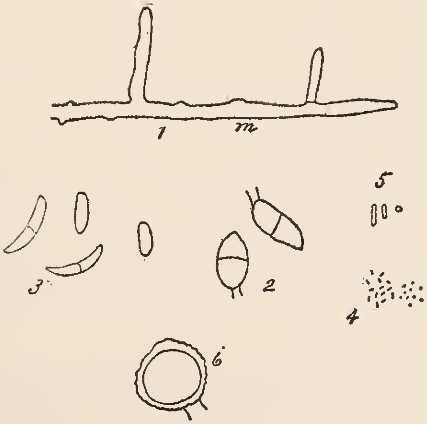

Fig. 106. Moulds and bacteria from corn. 1 and 3. *Fusarium heterosporum I* Mycelium. 3. Conidia. 2 and 6. Other moulds. 4 and 5. Bacteria. After Pammel and King.

places, the fungus investing the whole kernel. Rostrup mentions it as destructive to germinating barley. It also occurs upon ergotized rye and is regarded by some mycologists as distinct from *Fusarium culmorum*. It is probable that the various species of Fusarium infesting cereals should be referred to one species.

Poisonous properties. Whether this fungus is responsible for the disease referred to by Dr. Mayo and other veterinarians, has not been definitely determined. It is true that experiments made by Dr. Bitting, this writer, and others, show that no doubt the Fusarium fed in considerable quantities to cats and dogs has had an injurious effect. Cats did not relish milk in which this material had been placed. If nothing more, Fusarium may be looked upon as producing stomatatis. Prof. Sheldon refers this fungus to *Fusarium moniliforme*. In the diseased horses reported by Dr. Peters the horses would lose their hair and hoofs and were said to be alkalied. Cattle and hogs were likewise said to lose their hair. Feeding experiments conducted on hogs with this corn as well as with pure cultures reproduced the symptoms in experimental animals. In this connection this statement of Dr. Law's is of interest:

> Fodders affected with cryptogams or bacterial ferments are undoubtedly at times the cause of encephalitis. Veterinary records furnish many instances of wide spread attacks of stomach staggers, abdominal vertigo, and cerebro-spinal meningitis in wet seasons, when the fodders have been harvested in poor condition or when from inundation or accidental exposure they have become permeated by cryptogams and microbes. Among comparatively recent accounts of this are those of Martin and Varnell (musty oats), Lombroso, Depre, Erbe, Pellizi, and Tireli (smuts), Bouley and Barthelemy (musty fodder), and Ray (fermented potatoes). One of the most extended local outbreaks of cerebro-spinal congestion I have ever seen, occurred in the pit mules of the Wilkesbarre coal mines, while fed on Canadian hay which had been soaked with rain in transit and had undergone extensive fermentation. It should be noted that there were the attendant factors of overwork, in anticipation of a strike, and a Sunday's holiday above ground in a bright summer sunshine.
>
> The experimental administration of moulds, smuts and microbes, have in the great majority of cases led to little or no evil result (Gamgee, Mayo, Dinwiddie, etc.) and there is a strong tendency to discredit the pathogenic action of these agents in reported outbreaks. The safer conclusion perhaps would be, to recognize the fact that they are not equally pathogenic under all conditions of their growth and administration. The oft-recurring epizootics of brain disease in connection with wide spread spoiling of the fodders in remote and recent times, probably imply that cryptogams or microbes and their products, plus some condition not yet fully understood, are efficient concurrent factors. If we can discover this as yet unknown factor and demonstrate that it operates with equal power in the absence of cryptogams and ferments, as in their presence, it will be logical to pronounce these latter as non-pathogenic under all circumstances. Until then cryptogams and bacteria must be held as probable factors.
>
> In recognizing how much cryptogams and bacteria vary under different conditions of life, and what various products they elaborate at different stages of their growth, we can theoretically explain the absence of the disease at one time and its presence at another under what seem to be identical circumstances, as also the variety of symptoms shown in different outbreaks. While this causation cannot be said to be absolutely proved. it is not antagonistic to the facts in many of the best observed outbreaks, and may serve as a hypothetical working theory until actual demonstration can be furnished. The affection suggests a narcotic poison introduced from without, rather than a disease due to a germ propagated in the system.
>
> In all probability as we learn more of the true pathology of the disease, we shall come to recognize not one, but several toxic principles, and several different affections each with its characteristic phenomena in the somewhat indefinite affection still known as cerebro-spinal meningitis.
>
> The malady has been described in horses, oxen, sheep, goats and dogs, attacking by preference the young, which are not yet inured to the unknown poison, and by preference in winter and spring, the periods of close stabling, dry feeding and shedding of the coat.

Dr. R. A. Craig of Indiana reports as follows in regard to interesting experiments made at the Indiana Station:

> In January, four sacks of spoiled, mouldy corn were gathered from a stalk field adjoining a field in which cattle had developed cornstalk disease. A healthy heifer weighing three hundred and fifty pounds was fed four to five pounds (twelve to seventeen ears) of this corn twice a day. In addition stover was fed. On the afternoon of the sixth day of the test the heifer appeared weak, went down in the stall and was helped up twice in the afternoon. When down she struggled some, and when helped up "shivered" as if cold. In the evening she was still trembling and appeared weak. The weakness disappeared the following day. A few days later a slight twitching of the body muscles was noticed. The feeding test extended over a period of sixteen days. Her appetite remained good throughout the test.

Dr. Craig adds the following:

> During the fall and early winter of 1898-'99, Bitting reported losses in horses and cattle, supposed tò have been due to feeding on spoiled corn. By feeding corn meal that was inoculated with a pure culture of a mold (Fusarium sp.) made from the spoiled corn, he produced salivation and redness of the gums of the two horses used in the experiment. Later spoiled corn was fed. On the fifth day one horse showed a slight salivation, colicky pains and diarrhoea. On the seventh day, noticeable incoordination in moving about and stupor. For two days the animal stood with the head pressed against the wall. A quick recovery followed and the nervous disease from which horses were reported as dying did not develop. The second horse showed nothing more than a slight irritation to the mouth.

Because of the close resemblance between toxic poisoning from sorghum and the symptoms of corn stalk disease, Price deemed it advisable to examine cornstalks for the substances which produce prussic acid in plants. Samples of stalks from fields in which cattle had died were obtained. In these samples he discovered an enzyme which had the property of decomposing a glucoside (amygdalin) and thereby poison as a result of enzyme was found. However, no glucoside capable of forming this poison as a result of enzyme action was found. The results were not regarded as conclusive, as only a few samples were examined, and the failure to discover a suitable glucoside did not prove its absence in the corn plant, or in other plants in the field.

Dr. Peters says in regard to the feeding of moldy corn to horses as follows:

> Numerous reports have been received from stock owners of a disease which they call cornstalk disease or spinal meningitis which affects horses in the stalks and also some which have not been in the stalks.
>
> This disease is very rapid in its course. For this reason it is sometimes difficult to see animals alive or in the beginning stages of the disease. In the later stages the animals are usually in such violent excitement that the symptoms have to be studied from a distance. One peculiar feature about the disease is that it comes on without warning, often attacking an animal while at work. One of the first symptoms noticed is the refusal of feed. Some have observed an excessive thirst and a difficulty in swallowing. The head is drooped in a very peculiar manner, denoting dullness. The eyes become very dull and later almost totally blind. This is usually followed by delirium and death. When a horse becomes affected in the stall it sometimes presses its head against the manger or wall and as this symptom increases in violence it is not uncommon to find the stall and manger demolished. Another peculiarity of the disease is that just before the animal becomes violent, one can cross its legs and the animal will remain in the position semi-conscious for some time.
>
> This disease has been attributed to many causes. It is practically conceded at this time that it is due to a fungus found on the food administered. Feeding experiments with mouldy corn at our Station and other Stations, have proven that mouldy corn is capable of producing this disease. In March, 1902, a quantity of mouldy corn, which was taken from cribs of a farmer at Graf, Nebr., who had lost a number of horses with this disease, was fed to four horses. These horses were fed exclusively on this corn with a small quantity of good hay and on April 2 two of the horses were found to be affected, the symptoms being

the same as those in animals that died in various parts of the state. The black horse, John, was found in the afternoon of April 2 to be swaying in his gait. He refused feed, had the peculiar dullness of the eyes, and when his limbs were crossed he remained in that position entirely motionless for some time. The next morning the animal was very much worse and at noon he was killed so that an autopsy could be held. The post-mortem examination showed that all organs were practically normal except the brain which was much softer than normal. I will quote the description of the post mortem as given by Dr. Butler, which is as follows: "On removal of the brain the superior surface of the right cerebral hemisphere was noticed to be slightly flattened over the anterior half. Palpaticn revealed a soft spot at this place. An incision through the apparently sound gray matter revealed what Mayo described as a sereous abscess in which floated flocculi of broken down brain substance, which presented the appearance, as one stockman said, of a mixture of vinegar and curdled milk. This portion of softened and broken-down white brain substance is in no sense a serous abscess. The line of demarcation between the broken-down and the healthy brain substance was not clearly marked, but surrounding the completely broken-down portion of a zone probably half an inch thick that was softer than normal and of a slightly yellow color. The liquid in the cavity, and in which floated portions of soft and partially broken-down brain substance, was slightly yellow, but in no instance was clotted blood or any other microscopic evidence of a hemorrhage to be found."

Dr. Butler and Dr. Mayo conducted an experiment with some mouldy corn from a farmer who lost four registered Percheron horses at Wakefield, Kansas. Four hundred pounds of the worst of this corn and fifty pounds of the chaff and screenings were sent to the Agricultural College in Manhattan, Kansas, and a feeding experiment was started with two colts, twenty-three months old. The experiment began on July 16, when each colt received 1½ kilos twice daily. On July 22, they were fed 1½ kilos of corn and cob meal twice daily. On the 26th of July 1¾ kilos of the damaged corn, well ground, cob and all. This was continued until August 19. One colt died August 21. Another experiment was conducted with a two year old colt, but fed with mouldy corn and good prairie hay. The temperature of the animal varied from 101-102° F. This colt died on July 26, the feeding experiment having

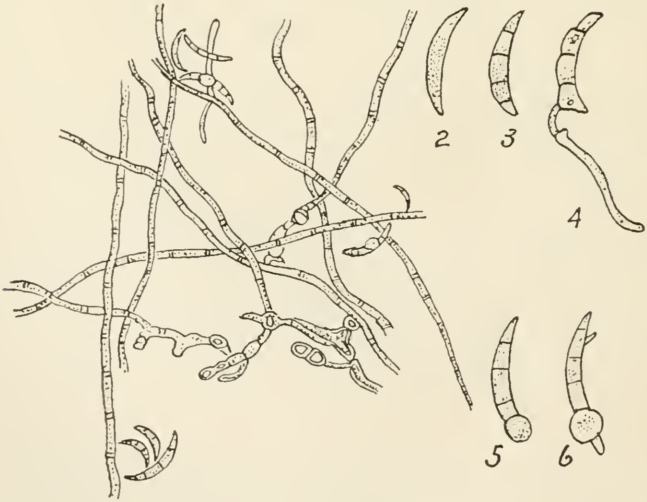

Fig. 107. Dermal mycosis associated with Sarcoptic mange caused by *Fusarium equinum*, conidia and mycelium. 2-6. Conidia (macroconidia) in various stages of development. 4. Germinating. After Melvin and Mohler.

begun on June 30. It was observed that after three weeks there were no notable changes except a gain in flesh.

It seems to me that there can be no question from these experiments that mouldy corn is dangerous to feed to animals.

Oxen, sheep, and dogs are also affected with a form of meningitis, due to mouldy conditions. Of course, it should be stated that in the above description by Dr. Law, no special mould fungus is referred to.

Fusarium equinum, Norgaard. Itch Disease of Horses

Mycelium immersed, septate and branched; conidia in cultures sickle-shaped, segmented; in hair sacs and sebaceous glands spindle-shaped or crescent-shaped bodies.

Drs. Melvin and Mohler supplement the above characters as follows:

> The Fusarium possesses three forms of spores, the microconidia small and oval, non-septate or two celled; the marcroconidia, large falcate, with sharp lanceolate ends, 3-5 septate, forming many aerial threads; 25-55 μ long $2\frac{1}{2}$-$4\frac{1}{2}\,\mu$ wide; the chlamydospores oval or oblong, thin walled, densely granular, 8-15 μ in diameter. The macroconidia occur during the later stage of growth. On culture media there is a white growth which becomes slightly colored. The most favorable medium is potato and sterilized bread, but it grows well in agar, glucose, or saccharine agar.

Distribution. North America, California to Idaho.

Pathogenic properties. In December, 1901, Victor A. Norgaard contributed to Science an account of a disease affecting horses, said to be produced by a fungus to which he suggested that, pending investigation, the name *Fusarium equinum, nov. spec.* be given. The following is an abstract of the article in question:

> An epidemic skin disease appeared among the horses on the Umatilla Indian Reservation, Pendleton, Oregon, upwards of sixty percent out of six thousand horses having been affected. The disease manifested itself through severe itching and loss of hair over almost the entire body. Many of the animals died of starvation. An examination of samples of the skin was made in the Pathological Division of the Bureau of Animal Industry and the presence of *Sarcoptes equi* observed. However these parasites were not present in sufficient numbers to account for the almost complete alopecia, and examination of samples almost entirely denuded of hair failed to show their presence. Microscopic examination of sections of the skin stained with borax blue showed the presence of large half-moon, spindle shaped bodies, deeply stained, in the hair sacs and sebaceous glands. Further culture produced from one to five circular colonies of a fungus which grew rapidly and assumed a salmon pink color. Cover-glass preparations made from these colonies contained numerous sickle-shaped segmented spores, characteristic of Fusarium. Of the twenty-five known varieties of this fungus, according to Dr. Erwin F. Smith, hitherto none has been known to be pathogenic to animals.

Drs. A. D. Melvin and J. R. Mohler have given a somewhat more extended account of this form of dermatomycosis. They found present with the disease the *Sarcoptes scabei.* In 1901 the disease appeared in a very aggravated form, some 2,500 animals were diseased out of 6,000 animals on the Umatilla Indian reservation. It is supposed that this disease was introduced from California in 1902 from trailed horses. It appears that the fungus apparently enters the hair follicles, penetrates between the cells of the epidermis or abrasion of the skin and involves the surrounding cuticle, causing irritation, followed by pruritis, the animal attempting to rub itself against anything with which it comes in contact. When the scurf is rubbed off by the finger nail there is left in its place a red moist denuded surface. It affects almost the entire body except the knees and hocks. The crusts are of gray color at first but turn darker. When the tissue is examined microscopically, the spores are found to be abundant in the hair follicle, the fungus causing the hair to drop out. The inflammatory process spreads in the sebaceous glands causing a suppression of the excretion with the formation of crusts anl scab. Occasionally Sarcoptes were found but Drs. Melvin and Mohler do not believe that they were the principal cause of the disease, although when present the animal parasite may aggravate the trouble. All ages and breeds of horses are susceptible as are both sexes. The animal stands around the rubbing posts all day and finally dies.

Rabbits, dogs, guinea pigs are immune. Experiments with horses were not successful, which these writers think may be because the right stage of the fungus was not used for inoculation experiments.

Treatment. The authors recommend dynamo oil and sulphur in the proportion of one pound of the latter to a gallon of oil. Coal tar sheep dips have also been used.

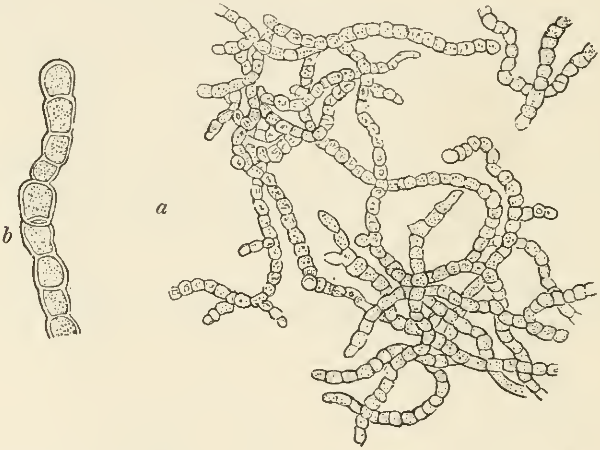

Fig. 108. Favus of mouse (*Oospora porriginis*) from a culture. a. Mycelial threads. b. A single thread more highly magnified. After Flügge.

Oospora, Wallr.

Fungus with small tufts spreading or pulvinate, mucedinous, loose, or somewhat compact; fertile hyphae, short, with few branches; conidia transparent, usually in chains, globose or ovoid, hyaline or slightly colored.

Oospora porriginis (Mont. and Berk.) Sacc. *Achorion Schönleinii,* Remak.

Favus, Tinea favosa. Honeycomb Ringworm

Mycelium flexuose, simple, branched, or forked, continuous conidia, ovoid, triangular or somewhat cubical, varying 3-6 μ in diameter; mycelium in masses with granular protoplasm occasionally branched at the end, the ends swollen, club-shaped, branches of the mycelium with lateral branches; spores oval, round or angular, 3-8 μ long and 3-4 μ wide, single or in chains. The threads of the fungus are readily detected in the bulbs and the shafts of hairs when sodium nitrate or potassium hydroxid is added, but at a distance of two inches the fungus cannot be detected. Sections of the nail stained also show threads of the fungus. This fungus has been cultivated in ordinary agar or by Kral's method. It grows well at higher temperatures, and in 24-48 hours the fungus threads appear. The spores germinate at 35° C. in 14 hours, and in 24 hours a fine mycelium appears in the air. In nutrient media like potato, gelatin and agar, chlamydospores and yellowish bodies appear. The organism requires higher temperatures for its best development, the optimum is 35° C. The organism from some of the lower animals, however, grows at lower temperatures.

According to Walsch the best development of the fungus in the hair is near the upper end of the root, from here it extends upward or downward; the mycelium may be exfollicular or on the surface of the hair.

The favus of man does not differ especially from that of animals except in color, and in the shorter duration of the disease in animals.

Distribution. Widely distributed in Europe and North America, but, according to Hyde and Montgomery, less common in the United States, Austria, and England, than in France, Scotland and Poland.

Pathogenic properties. This form of dermatomycosis known as Favus was discovered by Schönlein in 1839. In the middle ages, it was known as Tinea, meaning a moth or worm. Previous to the discovery of the organism by Schönlein, various troubles were classed as favus.

Heusinger suspected the fungus nature of the disease as early as 1826. Remak, in 1845, cultivated the organism upon apple and transmitted it to his arm. He named the fungus *Achorion Schönleinii* and in medical literature it is frequently referred to by this name.

The favus organism of mice was discovered in 1850 by Bennett and recognized by subsequent investigators like Schroeder and Simon. Favus of cats, guinea pigs, and dogs was recognized by Saint Cyr. Gerlach found it in birds, and Gruby, three years after the discovery of the organism by Schönlein, found it in hairs on the heads of children and the hairs of the beard. In recent times, various views have been expressed with reference to the nature of favus and trichophytosis, it being held that these diseases are produced by different fungi. Pick in 1887, Walsch in 1896, and others considered the fungus to be polymorphic. Quincke distinguished three varieties but pathologists are not agreed on this point. Plaut, in his discussion of the parasitic fungi, divides them into the following groups: the Favus and the Trichophytic groups. According to this view, the favus of man and that of animals are regarded as distinct fungi.

The disease in man generally appears where hairs occur, but may appear also in other parts of the body as the eyes, nails, etc., seldom becoming general. Favus of the nails is called Favus onychomycosis. In lower animals the disease may occur on the head, nose, ears, back and, more frequently, is generalized. Formerly this disease was common among the poorer classes. Today, it is not common in France, Holland, Scandinavia, Germany, England, Switzerland, Japan or America; on the other hand, it is rather frequent in Russia, Scotland, Italy, Spain, Asia, Austria and Egypt, young individuals being more susceptible to it than are older persons, probably acquiring the disease by contact. The disease is spread through spores of the fungus. The mycelium itself, according to Grawitz, is not capable of spreading the disease of animals. In man it is recognized by the development of minute yellowish or reddish points; delicate vescicles may surround these spots. Later, the fungus may develop a crust; the odor is very disagreeable, being compared to the odor of mice or the urine of cats.

Mice are most susceptible to the disease, cats coming next since they come in contact with mice which have favus, then dogs by means of the cats and finally guinea pigs.

According to the recent investigations of Frank (1891) three different types of fungi were isolated from mice, and Unna and Neebe in 1893, concluded that no fewer than nine species existed, three aerophilous and six aerophobic, as follows: *Achorion cutythrix, A. didikroon, A. atkaton, A. radians, A. akromegalicum, A. demergens, A. cysticum, A. moniliforme,* and *A. tarsiferon,* but these may probably be regarded as one widely-polymorphic species.

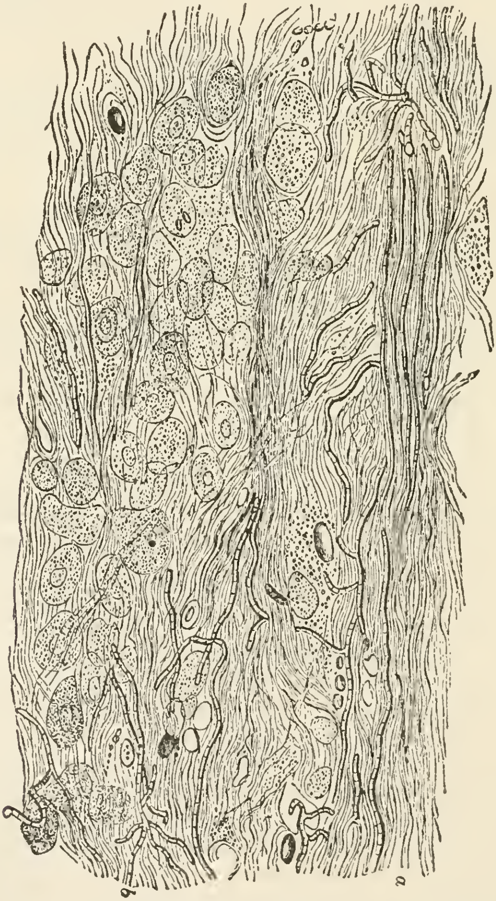

Fig. 109. Epidermis invaded by Sporotrichum. *a*—inferior portion of the *stratum corneum*; *b*—superior portion of the *rete.* Both exhibit long mycelial threads, with a few ramifications and a small number of spores. After Kaposi.

Sporotrichum, Link

Hyphae, branching irregularly and repeatedly, septate or continuous, usually equally procumbent; conidia, acrogenous at the apices of the main and lateral branches, usually solitary beneath, ovoid or subglobose. This genus differs from *Botrytis*, especially in all the hyphae being procumbent and the conidia subsolitary; from *Trichosporum*, in never being dark colored. Very many species, imperfectly described by older writers, show mere forms, or mycelia.

Sporotrichum Furfur. Rob

Pale yellow or yellowish brown to dark brown or brownish-red spots, varying in size from that of a lentil to that of a hand, either smooth or shining or dull exfoliating. Found on the breast, stomach, or back. Never upon the hands, feet, seldom on the face. Slender hyphae 3-4 μ wide, 7-13 μ long, variable as to length and thickness. The spores are clustered resembling oil drops. On potato a characteristic growth of yellowish, orange red brown, blackish or greenish color. Old culture is grayish, brownish or violet color. In 3-4 days a whitish gelatinous mass forms, which in 3-4 weeks covers the whole surface. Conidia are oidium-like, surrounded by thick hyphae, occur in scales, 4-7 μ, spherical. In cultures budding occurs.

Distribution. Common in some localities in Europe and America.

Pathogenic properties. Fehr in 1840 observed that most of the inhabitants in a Swiss village were infected through cattle. Bazin in 1853 observed that many cavalry men were infected through horses. Papa in 1840 observed that this disease was frequently transmitted to men. In cities it chiefly occurs in cats and dogs, and through these it is conveyed to men.

It is especially common in people with tender skins and in tubercular patients, and is more common with women than men. In 1846, Eichstedt dis-

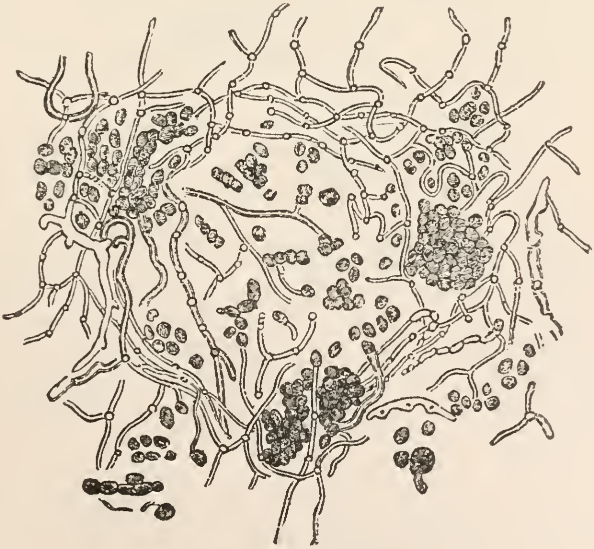

Fig. 110. Sporotrichum Furfur. After Kaposi.

covered the cause while Robin named the fungus *Microsporon Furfur.* Köbner, in 1866, made the first inoculation experiments.

Grawitz, in 1876, first cultivated the organism. His work was followed by that of such other investigators as Sehlen in 1890 and Koltjar in 1892, who succeeded in transmitting the cultivated fungus to guinea pigs and gave it the name *Oidium minimum.* It has also been named *Oidium Furfur.* Vuillemin also cultivated the fungus to which he gave the name *Malassezia Furfur.* Pure cultures of the organism grown on potato were transmitted to man.

Treatment. The best treatment, as recommended by Hyde and Montgomery, is a hot bath, the skin being rubbed with soap; following this the skin is bathed with clean water and sponged with a solution of sodium hyposulfite, 1 drachm (4) to the ounce (30).

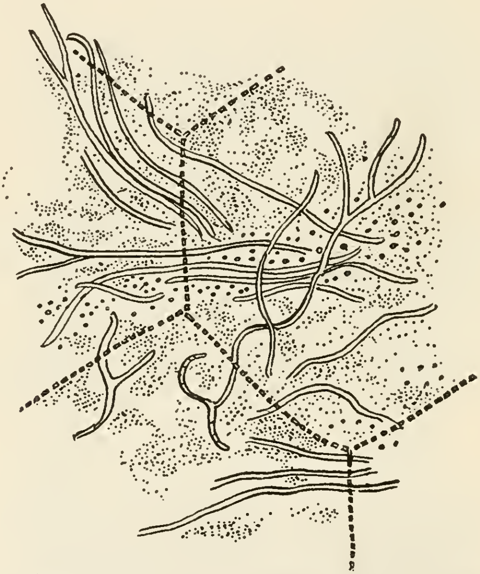

Fig. 111. Erythrasma Fungus. *Sporotrichum minutissimum.* After Hyde and Montgomery.

Sporotrichum minutissimum (Burckhardt.) Pammel. Erythrasma

It begins as small brown or reddish patches which become confluent; these spots may become as large as the palm of a hand and occur in the axial region; the scales contain Leptothrox-like threads which are branched and septate; conidia small, round or angular. It grows well on agar agar, glycerine agar, gelatine, potatoes, and in blood serum. In nutrient media, branching, septate hyphae 0.8-1.3 μ in thickness and 5-15 μ in length are seen; the short hyphae break up into numerous spores.

This disease was first observed by Burckhardt in 1869 and since has been observed by others. It occurs in the form of roundish or punctiform patches, sharply contrasted with the adjacent tissues. The younger areas are livid red while the older are yellowish or brownish.

A so-called Dhobie itch of the Philippine Islands is in part caused by this fungus. Though Hyde and Montgomery state that there are two other types of infection known by this name, one is trichophyton and one of bacterial origin.

Sporotrichum giganteum, (Unna). Pammel

Spores are free or in chains in nutrient medium 1.5-7 μ in diameter, the oval 4-5x5-6 μ, yeast-like budding resembling *Oidium lactis* also occurs; ectospores as well as chlamydospores present, the latter 8-12 μ in diameter with strongly refringent bodies: in cultures ray like, the rays consisting of hyphae and spores, in liquid media only hyphae with ectospores. In the hair, knot-like bodies are formed with spores and hyphae embedded in mucilage.

The Colombia disease was described as *Trichosporon giganteum*, Unna. It is a polymorphic fungus and the *T. ovoides*, Behrend is included but by some is regarded as different. The knotty masses of hair are less thick, and the spores are oval in shape; gelatine not liquefied. The superficial colonies resemble *Oidium lactis*. Chlamydospore 4-12 μ in diameter.

Other species of *Microsporon* have been described like *M. canis* in dogs. *M. tigris*, the *M. equi*, in horses and colts and another species in cattle. In calves a similar form occurs. The sheep are said to have the disease on the neck and breast; it also occurs in hogs, goats, and birds. These forms are said to differ slightly clinically. Pus is formed in follicles, and the hair is especially prone to drop out. A bad smelling liquid of a reddish color occurs. In lesions large spores, the ectospores, occur. The Oidium chain like spores occur chiefly in the roots of the hairs.

Pathogenic properties. The disease is especially common in animals in which the skin is naturally fine, thin, and dry, and covered with hair sparsely, more common in the Arabian Barb, English racer, and American trotter of nervous organization than in heavier draft breeds. Old horses are more subject than young ones. Extended desquamation, excessive production of epidermal scales without any elevation of the skin, scurfy products may be found in patches scattered over the body; generalized or circumscribed as to the head, ears, crest and tail; the hair may be pulled out with great ease. In cattle it occurs on neck and develops in connection with anaemia, spoiled fodder, and constitutional predisposition. Affects especially the head, neck, and back of dogs gorged with dainties and those becoming aged. The affected parts are covered with a floury or bran-like product lying upon a dry surface, the affection being usually limited to certain areas more or less destitute of hair. In the cat it may affect the whole dorsal aspect of the body, being associated with extreme electrical susceptibility, the hair when touched, collecting in tufts. The scaly product is abundant.

Animals are said to spread trichophytic fungi, which supposition is important from a hygenic point of view. Since the disease sometimes occurs in school children, separate hooks for clothing and separate towels when bathing the hands and faces are recommended. A one per cent solution of bicloride of mercury will kill the fungus.

The disease was first described by Osorio in 1846, and was then thought to be confined to Colombia where it was called Diedra (Stone), but later was found in Europe, and Vuillemin reported it from Paris in 1902. Desenne of

Paris discovered the hyphae of the fungus and Malcolm Morris the spore-like bodies. Behrend in 1890 succeeded in cultivating the fungus.

Sporotrichum tonsurans. Barber's Itch

Hyphae slender 1.5-2 μ in diameter, straight, undulated, dichotomous, septate or non-septate, penetrate the hair follicles forming a matted mycelium, small pustules and scabs; in places devoid of hairs it forms red, scaly spots, discs and circles. The fungus is found between the uppermost layers of the epidermis just beneath the corneous stratum; the conidia are small, spherical or elliptical, sharply defined 2-3 μ in diameter; the spore masses surround the root of the hair and are frequently densely and closely arranged like beads; in culture media like agar, a many-rayed fungus occurs, the color varies with the medium, yellow, Bismark brown, cherry red, violet, rose, brown, blackish brown; gelatine liquefied; spores swell after a few hours and produce 1-2 germ tubes from a single spore; mycelium with occasional swellings, ectospores formed in 60-96 hours, also small, branched air hyphae; small conidia 1.5-3 μ in diameter borne on short, lateral branches. The Botrytis-like spores rise on the long, thin, curved air hyphae. Oidium budding does not occur in nutrient media. The spores retain their vitality for six months but exposure to 45° C. for a few hours will kill the organism; it is sensitive to sunlight and common disinfectants. The fungus is polymorphic, one form having been classed, by Sabourne, with Botrytis. The large-spored trichophyte found on the scalp germinates at 37° C. in a few hours; but at room temperature, a much longer time is required.

Conidia 5 μ in diameter, an abundant mycelium with dust-like growths, and, in three days, oidium-like spores, as well as ectospores, are produced on the potato, the disease being known as *Tinea Sycosis.*

The *T. circumscripta* produces, in animals, cherry patches each with a raised border and scales, and is also found on the head, arms, and neck, of man. *T. disseminata* produces small red pustules.

To *T. tonsurans,* also, is attributed *Eczema marginatum* which Kobner, while making a study of trichophytic fungi in 1864, recognized as a trichophyte. He also determined that the fungus on the nails, described in 1853 and 1855 by Baum and Meissner, was a trichophyte.

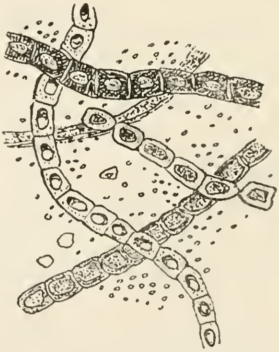

Fig. 112. Barber's Itch. (*Sporotrichum tonsurans*) Filaments and spores. After Hyde and Montgomery.

Gerlach, in 1857-1859, demonstrated a trichophyte in bovine animals, and other investigators, later, recognized the case as *Herpes tonsurans*. *S. tonsurans* has also been described under *Trichophyton tonsurans* and as *Oidium tonsurans*. Unna, in 1897, from twenty cultures described four species, *T. oidiophora*, *T. eretmorphoron*, *T. atractophoron*, and *T. pterygodes*. It is probable that *Sporotrichum tonsurans* is a very variable species. Lindau places it under the genus *Oospora*, but it seems preferable to call it Sporotrichum.

Distribution. Occurs in Europe, North and South America, Asia and Africa.

Pathogenic properties. In cattle, small, round, sharply defined spots occur which are covered with scabs and scales which project more or less above the skin and vary in size, some being as large as the palm of the hand. Underneath the scales, is a purulent fluid with hollows that represent the empty follicle. In man as well as in animals, the hairs can be pulled out very readily. The eruption lasts from six to twelve weeks, outbreaks occurring from rubbing or scratching as a relief from the itching sensation that accompanies the eruption. In sucking calves it occurs chiefly about the mouth and is called "doughy mange" and, according to Hahn, is produced by the fungus *T. tonsurans*.

Most of the varieties can be transmitted to guinea pigs, cats, and dogs and have even been transmitted to man during the process of sheep shearing. Healing takes place when the animal is inoculated subcutaneously. The large-spored form, occurring on the scalp, forms pus and resembles moist eczema. Children take the disease from calves and by playing with cats and dogs.

Mycosis of the beard exists in two forms; non-infectious and infectious. In *Sycosis parasitaria*, the disease is accompanied by a severe inflammation of the hairy parts of the skin leading to infiltration and suppuration. Sabouraud classifies the parasite into a dry and a pus favus.

The *Eczema marginatum* supposedly caused by the same fungus was first described by Devergie in 1854-1855; Berensprung having discovered the same fungus in 1855. It is slightly contagious, and more frequent in men than in women. Another form of the disease occurs in the mouth. In sheep the wool is felted and beneath it are bran-like, scabby parts, the fleece becoming very ragged in appearance. In poultry, it shows itself by the loss of feathers. In horses, it occurs most often on the seat of the saddle. The spots vary in size, and the surrounding hair can be pulled out easily. In dogs, it affects the head and extremities. Usually the spots are round at first and sharply defined, later becoming hairless patches; occasionally they are dirty gray scabs.

Ringworm of the body or *Tinea circinata*, is characterized by the occurrence of one or more pea-shaped or large circular reddish patches which are on about the same level as the integument and rarely 5-6 inches in diameter. In some forms there is itching. This Trichophyton was discovered by Gruby in 1844. This fungus can be readily recognized by making microscopic mounts. The mycelium is less branched and the threads are more slender than in the form previously described. The spores are like strings of beads.

The ringworm of the scalp, *Tinea tonsurans*, is a disease, chiefly, of children, especially of those in schools. It differs from the preceding form in the fact that the fungus makes its way into the hair follicles. The patches are, at first, circumscribed, about the size of a small coin, covered or partly covered with roundish patches of slate gray color or a dirty yellow. The fungus is called *Microsporon adouini*.

Hyde and Montgomery state that there are at least two distinct and unrelated forms capable of producing ringworm, the *Microsporon adouini*, a small-spored fungus, and the *Trichophyton*, or large-spored fungus. The Microsporon appears under the microscope in the form of a large number of round spores, irregularly grouped or massed about the follicular portion of the hair. The mycelial threads are all within the hair proper while the spores terminate fine threads on the other surface of the shaft. The spores of Tricophyton vary greatly in size and are much larger than those of Microsporon. They are cuboidal, oval, or irregularly rounded. They occur in chains, up and down the hair or shaft. The mycelium is found without, never within, the hairs. The spores may be within (endothrix) or without (ectothrix).

Oidium albicans. (Robin.) Rees. Thrush

Forms a mould-like growth in the mouth of man and lower animals. Vegetative cells, yeast-like, spherical, elliptical, oval or cylindrical, 5-6 μ long, 4 μ wide, the elongated hyphae-like bodies variable in length; conidia elliptical in chains; grows well in nutrient media where it produces superficial, spherical, white, wax-like, granular colonies, varying color from reddish to white; chlamydospores in nutrient media and occasionally in the epithelial layer; it does not ferment lactose and saccharose, but ferments levulose and dextrose. According to Brebeck and Fischer there are two morphological forms of the organisms, a small oval and a large-spored form; however, this distinction is not generally recognized.

Distribution. Widely distributed in the United States, also in other countries, Germany, Austria, France, Italy, and Great Britain.

Pathogenic properties. John recognized the disease in 1816, while Buchner gave a somewhat detailed description in 1841. Langbeck and Berg dicsovered the fungus in 1839. It was thought by them that it was the cause of typhoid fever. Langenbeck demonstrated that the Fungus could be carried from a child, sick with the disease, to a healthy individual. Gruby, in 1847, described the fungus under the name of *Apthaphyta*, placing it near the fungus *Sporotrichum*, while Robin, a French author on parasitic diseases, considered the fungus to be an *Oidium*, naming it *Oidium albicans*, a name frequently used by authors. Rees, however, placed it with the yeasts. *Monilia candida* is regarded by Plaut and Lindau as a synonym. Grawitz, in 1877, made pure culture of the fungus and succeeded in producing the disease in guinea pigs. Klemperer found that when the fungus was inoculated into the circulatory system of guinea pigs, general mycosis resulted. Limossier and Roux (1889-1890) in their monograph, state that the mycelium occurs in the blood vessels of inoculated animals.

The fungus is very common in some sick chambers in regions where the disease is prevalent. It is most abundant in sucklings.

It occurs frequently in children of premature birth, and in weak children; the fungus is also found in aged persons, suffering from disability; it occurs chiefly upon the mucous membrane of the mouth, pharynx, and oesophagus; more rarely, upon that of the stomach, intestine and vagina, and upon the nipples of nursing women and bovine animals. It has also been found in the liver, kidneys and lungs; it penetrates the epithelium and even into the underlying, connective tissue; it is spontaneous in such animals as calves, birds, and foals. The disease is fatal in many cases, some authors estimating the death rate as high as 22 per cent. Inoculated guinea pigs show a rise in temperature at first a lowering, accompanied by albuminaria, loss of flesh, and diarrhoea, death occurring in from 3-7 days. Immunity may be obtained in guinea pigs by beginning with small doses, and increasing these gradually to three times the strength. The product produced by the fungus is poisonous; 20-40 cc. of the whole substance will kill a guinea pig weighing one kilogram.

Dr. Stuhr has contributed the following upon this subject:

> Thrush is a mycosis of the mouth affecting children, calves, foals, and poultry, and is characterized by the formation of white patches upon the mucous membrane, which vary in size from points to large areas. It may involve the pharyngeal and laryngeal mucosae by extension. The disease is transmissable from man to animals. Young age, a weak constitution, gastric indigestion, uncleanliness, milky and starchy diet predispose. Decaying food in the mouth offers a suitable place for the growth of the fungus.

Etiology. The specific cause of thrush is a vegetable parasite, *Oidium albicans,* first described by Berg in 1840. It is one of the branching fungi closely related to the yeasts and grows readily on sour milk, in saccharine substances, on decayed wood, and on fresh cow manure. Calves fed milk from wooden pails which are not kept perfectly clean are particularly liable to contract the disease. The fungus descends into the epithelium and sometimes into the subjacent connective tissue, causing inflammatory infiltration and superficial necrosis.

Symptoms. The mucosa is diffusely red, swollen and tender, and shows adherent white patches, varying in size, surrounded by a red inflammatory zone. When these white spots are rubbed off, shallow red ulcers are exposed. When the inflammation in the mouth is severe, or when the disease spreads to the pharynx and interferes with deglutition the prognosis may become serious. Usually, however, the disease is benign and yields readily to treatment.

Lesions. These are usually superficially located and rarely extend deeply into tissues. They begin with diffuse reddening of the mucous membrane and the formation of a somewhat shining, slimy, adhesive layer of grayish-white matter which is said to have an acid reaction. Later whitish dots appear upon the surface and gradually spread, sometimes coalescing. These whitish patches are false membranes composed of detached epithelial cells with a ramifying network of parasitic threads. The white color of the false membranes is markedly in contrast with the congested surrounding tissue. While the lesions are ordinarily restricted to the mouth they may involve the pharynx, oesophagus, (in chickens), larynx and even the stomach and intestines. Metastasis may occur and the fungus be carried to various parts of the body.

Treatment. This is aimed at the destruction of the fungus and for this purpose many substances have been recommended. The mouth should be cleansed at frequent intervals with solutions of borax, sodium hyposulphite, permanganate of potash, or chlorate of potash, etc. The system should be built up by feeding soft nutritious food, and the sanitary conditions should be improved.

Oidium hominis. (Busse.) Pammel. Blastomycosis

Cells spherical or ovoid, variable in culture, 8 μ in diameter with strongly refringent bodies; in young cultures, nearly homogeneous and with oil drops; in old cultures, large cells with a thin membrane; culture, at first white, then grayish or yellowish, or yellowish-brown in plum cultures, in plum decoction black, gas-producing in sugar medium, grows well in ordinary media but preferably in acid; grows best at high temperature. (An organism isolated by Curtis produced white colonies with oval, or club-shaped cells, frequently producing capsules.) Grows readily in nutrient media, does not form a pellicle on the surface in liquid media.

Descriptions of several so-called species of Saccharomyces causing Blastomycosis will be added to the above. In their development, blastomycotic fungi resemble true hyphal fungi rather than yeasts. It is convenient to discuss them here until their true relationship has been determined.

Distribution. Found in Europe and America.

Pathogenic properties. It was first isolated from the left tibia of a woman thirty-one years of age, the disease having first manifested itself by a purplish-red spot and swelling. An operation was performed, but it failed to relieve the trouble, new foci making their appearance after the operation and finally becoming general, being accompanied with pus formation. The patient died in 13 months, the lungs, kidneys, and spleen having become involved. There was no oedema, the organisms found in the lungs and kidneys being marked by small, nodular swellings.

Large amounts of culture, when inoculated into guinea pigs, dogs, and rabbits, produce the disease followed by death. In another case described by Curtis in 1895, the disease occurred in a young man. The organism isolated is pathogenic for rats, mice and dogs.

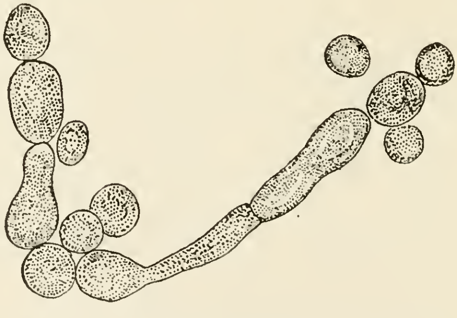

Fig. 113. Blastomycosis of the skin showing the elongated cells and budding forms. After Hyde and Montgomery.

Ziegler, in his General Pathology, summarizes our knowledge of the pathogenic properties of yeast as follows:

> As parasites no importance has been attached to them until very recently, but the investigations of Busse, Buschke, Sanfelice, Curtis, and others have established the fact that there are also species of Saccharomycetes of pathogenic importance. According to these observations, the pathogenic yeasts can multiply in different tissues, in the skin, periosteum lungs, and glandular organs, and can excite either purulent inflammations or proliferations of granulation tissue, which run a course similar to that of an infection with actinomycosis or tuberculosis. In inflammatory foci, the yeast cells are for the most part provided with a capsule. They may give rise to tumor-like swellings. Through degenerate changes, crescentic forms may develop from the oval yeast-cells.
>
> In solutions containing sugar the blastomycetes form oval cells. Reproduction takes place through budding and constriction; on any portion of the parent cell there may develop an excrescence, which is constricted off after it reaches the size of the mother cell. Under

certain conditions the cells may grow out into threads, but in these threads no subsequent segmentation occurs; jointed threads arise through budding (Cienkowsky, Grawitz). A dilute culture-medium favors the formation of threads.

Oidium granulomatogenes. (*Sanfelice*). Pammel. Blastomycosis

Forms nodular masses; grows in ordinary media; ferments sugar; uniform clouding of media; colonies white; the nodules consist of the fungus, giant epithelioid cells; causes a cheesy degeneration.

Distribution. Found in Europe.

Pathogenic properties. Pathogenic for hogs; occurs in the lungs, where it produces nodular masses.

Oidium lithogenes. (Sanfelice.) Pammel. Blastomycosis

The fungus occurs in the cancerous-like growth of the lymphatics; is frequently surrounded by lime, on agar and gelatin forms white colonies; in stick culture the growth is needle-like; sugar is changed into alcohol and carbon dioxid. Fungus consists of spherical bodies.

Distribution. In Europe.

Pathogenic properties. Pathogenic for guinea pigs, white rats, sheep, and cattle, producing nodular enlargements, frequently surrounded by a calcareous capsule.

W. W. Hamburger, in a recent number of the Journal of Infectious Diseases, refers to a morphological and biological study of blastomycosis as follows:

1. The strains of organisms appear nearly identical, so far as growth in test-tubes goes. A few minor differences are summed up below.
2. The organisms grow vigorously on the usual laboratory media, with perhaps a slightly more abundant growth on faintly acid glucose-agar.
3. Temperature is perhaps the most important factor in varying the gross and microscopic morphology; room temperature favors production of mycelia and aerial hyphae; incubator temperature inhibits production of hyphae and favors coherent, waxy, yeastlike colonies (budding forms).
4. Those cultures which produce yeastlike growths at incubator temperature develop hyphae within 24 hours when withdrawn and placed at room temperature. Likewise the majority of yeast-like colonies will finally (in 17 to 30 days) show evidence of beginning hypha formation even if kept at 37 degrees C.
5. Glucose-agar stabs, and broth form the most serviceable culture media if a limited variety is at hand. Duplicates should always be made to control differences in morphology at room and incubator temperature.

1. Four strains of organisms isolated from four cases of generalized blastomycosis appear identical.
2. Pronounced variations in the gross and microscopic morphology of the organisms are produced by variations in temperature. As a routine for purposes of study cultures should be grown at both room and incubator temperatures.

Distribution. Found both in Europe and North America.

Pathogenic properties. Dr. Harris gives the following:

Towards the lower animals pathogenic properties vary very much with the culture, recently isolated cultures as a rule proving more virulent than older ones. Mice, guinea pigs, and dogs are most susceptible, succumbing often to subcutaneous and intraperitoneal inoculations, whilst the white rat, rabbit, sheep, and horse are more refractory; in all, the lesions may be localized in the form of abscesses, or general infection may ensue where subcutaneous inoculation is practised.

Dr. E. R. Le Count and J. Myers discuss the case of systemic blastomycosis of a Polish laborer.

The first noticeable departure consisted in a feeling of discomfort involving the chest on the right side extending through from front to back, later cutaneous lesions appeared, located below the left ankle and extended down to the heel. He was obliged to stop work in December. The patient was emaciated, pale, anemic, and weak. Marked oedema was present in the ankles, feet, face and arms. His nails were clubbed; inguinal adenopathy was noted. From the lesions blastomycotic fungus was isolated, the sputum also containing the organism.

Eisendrath and Ormsby described the cultures as follows:

> On March 22nd pus was removed from a subcutaneous abscess on the left forearm, which was inoculated on various media. Six days later growth was plainly visible, and after this time the cultures grew rapidly. These proved to be pure cultures of blastomycetes. . . . . In the pus they occurred as circular forms and budding forms, having a double contour and the usual refractile capsule. On media the growth varied. It presented a moist, pasty surface on glycerin-agar, with at times a wormy appearance or else presenting large folds and depressions. Microscopically, these cultures showed many oval and circular organisms, some budding ones, and much mycelial formation, the latter being both coarse and fine containing sporules. Lateral conidia occurred. On glucose-agar the growth was more dry, white, and presented aerial hyphae; and microscopically there were fewer circular and budding organisms and more fine mycelia. On both glucose and glycerin-agar the media were penetrated to a considerable depth in a semi-circular manner.

Drs. Le Count and J. Myers say, as follows:

> The body was examined a few hours after death and the following anatomical diagnosis made: Blastomycotic bronchopneumonia; blastomycosis of the peribronchial lymph nodes, of the pleura, the subpleural, and retropharyngeal tissue, the liver, the kidneys, the colon, the spinal column (dorsal vertebrae), the external spinal dura, the cerebellum, the left elbow, both knee and ankle joints, and of the skin and subcutaneous tissue with ulcerations, fistulae, and scars. Fibrous pleuritis. Passive hyperemia of liver and spleen. Serous atrophy of adipose tissue. Emaciation. Adenoma of thyroid and accessory spleen.
>
> One notable feature of this case is the large conglomerate blastomycotic nodule in the cerebellum. In only one other case of systemic blastomycosis, that of Curtis', is there any record of changes in the nervous system, and the statements in that instance are solely clinical, death being due to meningitis. The reproduction by a process of sporulation demonstrable in the cerebellar lesion is likewise a new feature of the changes encountered in the lesions of this disease. The idea that in the nervous tissue the fungus may have found favorable or different conditions of nutrition, as an explanation for this method of multiplication, is opposed by the facts that the regions in which it was found were very minute, that it was not generally present in the cerebellar process, and the budding was commonly observed in the "abcesses" in the partitions between necrotic regions.
>
> Highly interesting is the relationship between this case of blastomycosis and one of coccidioidal disease described by Ophuls. Up to the present two of the chief differences between blastomycosis and coccidioidal granuloma have been the endosporulation observed in the tissues in the latter disease and its tendency to spread by the lmyph channels. Although no widespread extension by the lmyphatics was demonstrated in the case reported here, the extension to the tracheobronchial glands and in peribronchial lymph channels is unmistakable; the endosporulation on the cerebellum in part also resembles the methods of production described for the organism of coccidioidal granuloma. Taken together, these features in this instance of systemic blastomycosis are in accord with the belief expressed by Ophuls of a close relationship of the organisms in the two diseases.

Ricketts, in an interesting monograph on "Oidiomycosis (Blastomycosis) of the Skin and its Fungi," gives the clinical history, cultural characters and histopathology of a large number of cases. The fungi are divided into three groups, (1) Blastomycetoid or yeast-like. (2) Oidium-like. (3) Hyphomycetoid. He says:

> There are two histological forms of the disease in the skin, the eosinophilous and the non-eosinophilous, the former being associated with the mould type of the organism. Aside from the infections considered in this communication, certain cases which have been described in the literature from time to time indicate that oidium-like organisms may cause other severe pathological conditions in man.

LICHENS

Symbiotic organisms consisting of higher fungi, chiefly of the class *Ascomycetes,* or rarely Basidiomycetes; the thallus consisting of algal cells enveloped by the mycelium of the fungus forming a felted mass. The algae are called gonidia and belong to the Cyanophyceae or Chlorophyceae. The reproductive bodies consist of spermogonia, which contain the spermatia. The asci contain the ascospores, and occur in apothecia. In the Basideal lichens, spores are borne on basidia. Lichens are sometimes divided into fruticose, crustaceous, and foliaceous; but a more natural classification arranges the lichens into the *Basidio-lichenes* and *Asco-lichenes,* with various families, such as the *Roccellaceae,* that contains the Litmus, *Roccella tinctoria*; the *Lecanoraceae,* containing the *Lecanora*; and the *Cladoniaceae* that contains the well known Reindeer Lichen, *Cladonia rangiferina.*

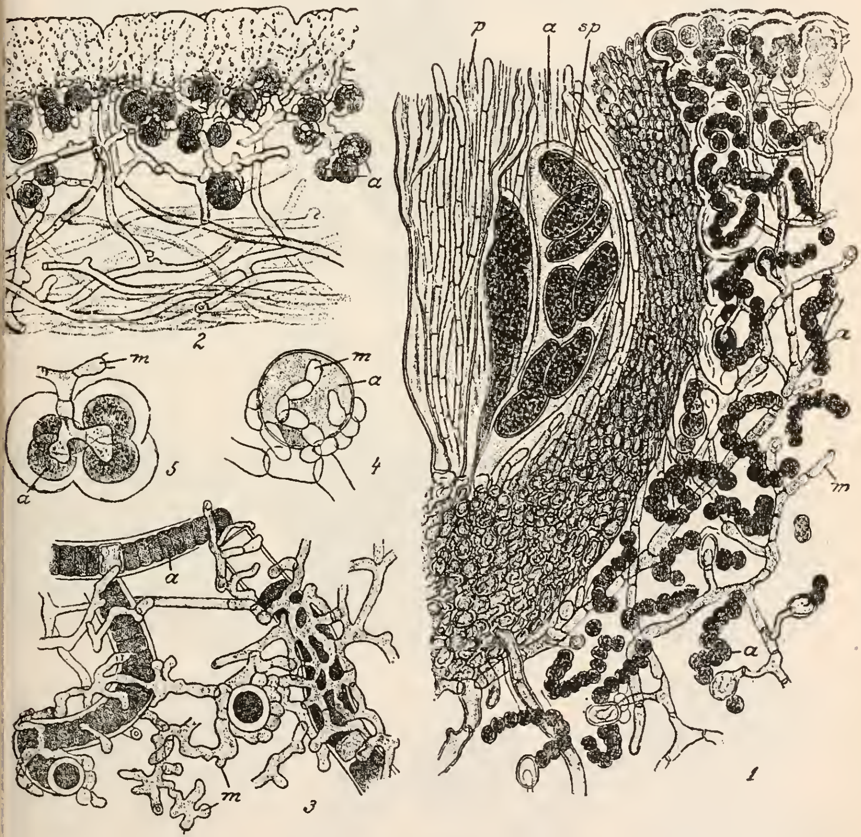

Fig. 115. Lichens, structure of Thallus and Apothecia. 1. *Plectospora minutula,* section through a part of the apothecium; *a* (at the right, below) Gonidia, *a* (above) ascus *sp* ascospores, *p* paraphyses; x500. 2. Section of thallus of *Cladonia furcata* x 330. 3. Portion of thallus of *Stereocaulon rumulosum; a* gonidia, *m* hypha. 4. Isolated gonidium (*a*) with attached hyphae (*m*) x 950. 5. *Synalissa ramulosa,* isolated gonidia (*a*) with attached hypha (*m*). After Bornet.

EMBRYOPHYTA ZOIDIOGAMA

BRYOPHYTA

Seldom thalloid, generally with stem and leaves with well marked alteration of generations. They contain antheridia and archegonia similar to those of the ferns. The antheridia are stalked, ellipsoidal, spherical, or club-shaped; the sperm cells are biciliated, the archegonia flask-shaped, the ventral portion with a large center cell, the lower portion divided into an egg cell and ventral canal cell. At maturity the new canal cells become mucilaginous and disorganized.

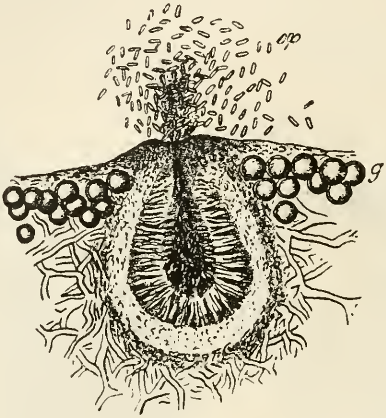

Fig. 114. Spermogonia of Lichen. *g.* Goniodia, fungus threads below. *sp.* Spermatia. Greatly magnified. After Tulasne.

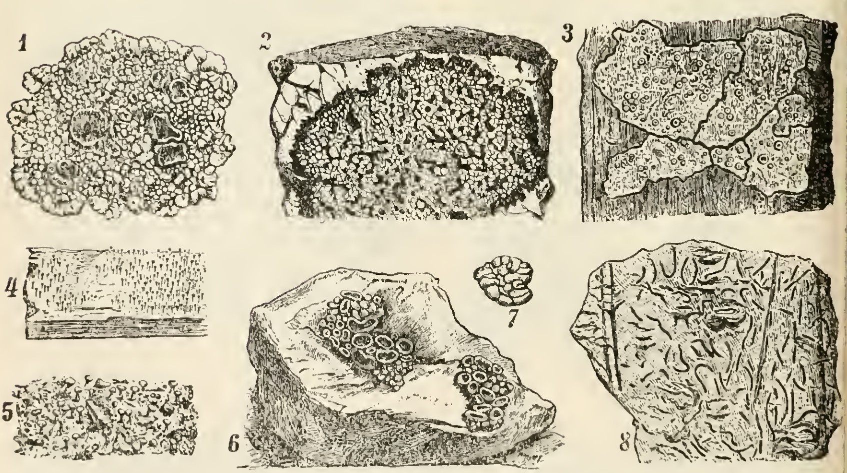

Fig. 115b. Lichens. 1. *Ochrolechia tartarea.* 2. *Rhizocarpon geographicum.* 3. *Lecanora subfusca,* on bark of tree. 4. *Calicum.* 5. *Bacomyces roseus.* 6. *Lecanora esculenta.* 7. No. 6 removed from substratum. 8. *Graphis scripta.* 1-8 after Wettstein.

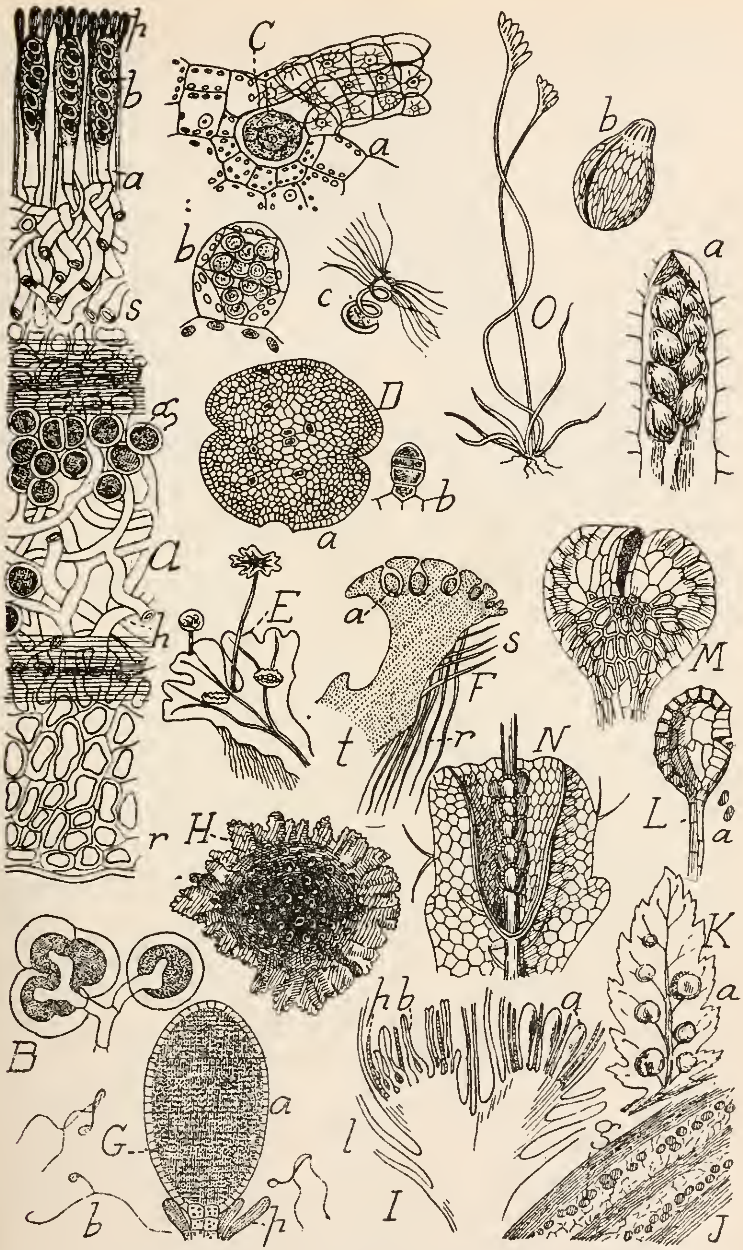

Fig. 116. *A.* Lichen—Iceland Moss (*Cetraris islandica*). *p.* Paraphyses. *a.* Asci. *b.* Ascospores. *s.* Subhymenial layer. *g.* Gonidia or alga. *h.* Hyphae. *r.* "Cortical" portion. *B.* Lichen. (*Synalissa sympharea*) sending its hyphae into an alga *Gloeacapsa.* C. Archegonium of fern (*Paiypadium vulgare*) with egg cell. *b.* Antheridium with sperm cells. *c.* Single coiled sperm cell. *D.* Liverwort (*Marchantia polymorpha*). *a.* Large gemmule or bud. *b.* Same section of thalloid structure bearing scales, *s.* *G.* Antheridium with sperm cells shown at *b.* *H.* Foliaceous lichen *Physcia pulverulenta.* *I.* Section of male plant of moss. *Phascum cuspidatum.* *a.* Antheridium. *b.* Archegonium. *l.* leaves. *p.* Paraphyses. *K.* Shield Fern (*Aspidium Felix-Mas*), pinnule bearing sori. *a.* *Indusium,* undernearth the sporangia. *L.* Sporangium of the same with ring and stalk with the spores at *a.* *M.* Sporangium of the Royal Fern (*Osmunda regalis*), No ring or mere traces. *N.* Filmy fern (*Trichamanes alatum*). *O.* *Schizaea pusilla.* *a.* Fertile pinnule with sporangia. *b.* Single sporangium with ring at small end.

the mucilaginous material acting as a servant to attract the sperm cells. After fertilization occurs, spores develop. In addition to the sexual method of reproduction an asexual reproduction also occurs. The gametophytic and sporophytic stage are sharply differentiated..

In the development of the sexual generation the spore germinates giving rise to a tube which develops into a new plant, and is called protonema. There are two divisions, the common mosses, and the liverworts. The parts of the fruiting moss plant are as follows: The *calyptra* or membranous cap which covers the capsule and soon falls off, exposing the *operculum*, which is a kind of lid, that is also thrown off. The *peristome* is developed within the operculum and contains teeth, between which the spores are discharged. The elaters in Marchantia are for the dissemination of the spores. The peristome differs in different genera; this affords a convenient means of classification. The spores are found in the capsule and running through the center is a slightly differentiated tissue, the columella. In *Funaria* the reproductive organs occur on different plants. The sexual organs are borne much like those of liver-worts at the apex of the stem. The antheridia occur in a small rosette of leaves and are club-shaped, the upper part consisting of a single layer of large chlorophyll bearing cells in which small cubical masses occur, the biciliated sperm cells. The archegonia occur in young plants and closely resemble the archegonia of liverworts, except that they have a larger neck. The spores germinate by producing a protonema which early produces a rhizoid.

The liverworts and mosses are much more highly differentiated than any of the Thallophytes, being characterized by more or less differentiation into tissues. Their life history presents a well marked alteration of generations. The gametophyte is more conspicuous than the sporophyte; the germinating spore produces the protonema, which consists of a branched filament, the cells containing the chloroplastids. The protonema is usually short-lived in the *Hepaticae* but in the true mosses is longer-lived and may persist from year to year. The moss plant is attached to the soil by small unicellular root hairs, or by many curled filaments which, in mosses, are called rhizoids. The shoots of mosses bear lateral organs known as leaves. In *Polytrichum* and *Mnium* the leaf consists, essentially, of a single layer of cells except on the midrib. In the leafy-stemmed liverworts like *Frullania* two rows of lateral leaves occur. In *Marchantia* the leaves are rudimentary and occur on the under surface of the thalloid structure in the form of small scales. The small dots on the surface represent the stomata which are dome shaped structures consisting of a number of cells on each side. The stomata communicate with the photosynthetic system of the plant.

Bryophytes are divided into two classes, the liverworts — Hepaticae — and the Mosses — Musci, the latter represented by spagnum moss — Polytrichum, Bryum, etc.

The mosses are distinguished from the thallophytes by their sexual reproduction, the antheridia or male organs are stalked, ellipsoidal, or club-shaped, and enclose small cubical cells, in which the ciliated sperm cells occur. These are ejected, float about in the water till the female reproductive organ, the archegonium, is reached. This is a flask-shaped body containing a neck and an egg cell. At maturity the upper part of the canal cells become mucilaginous, the sperm cells pass down through the canal to the egg cell, where fertilization

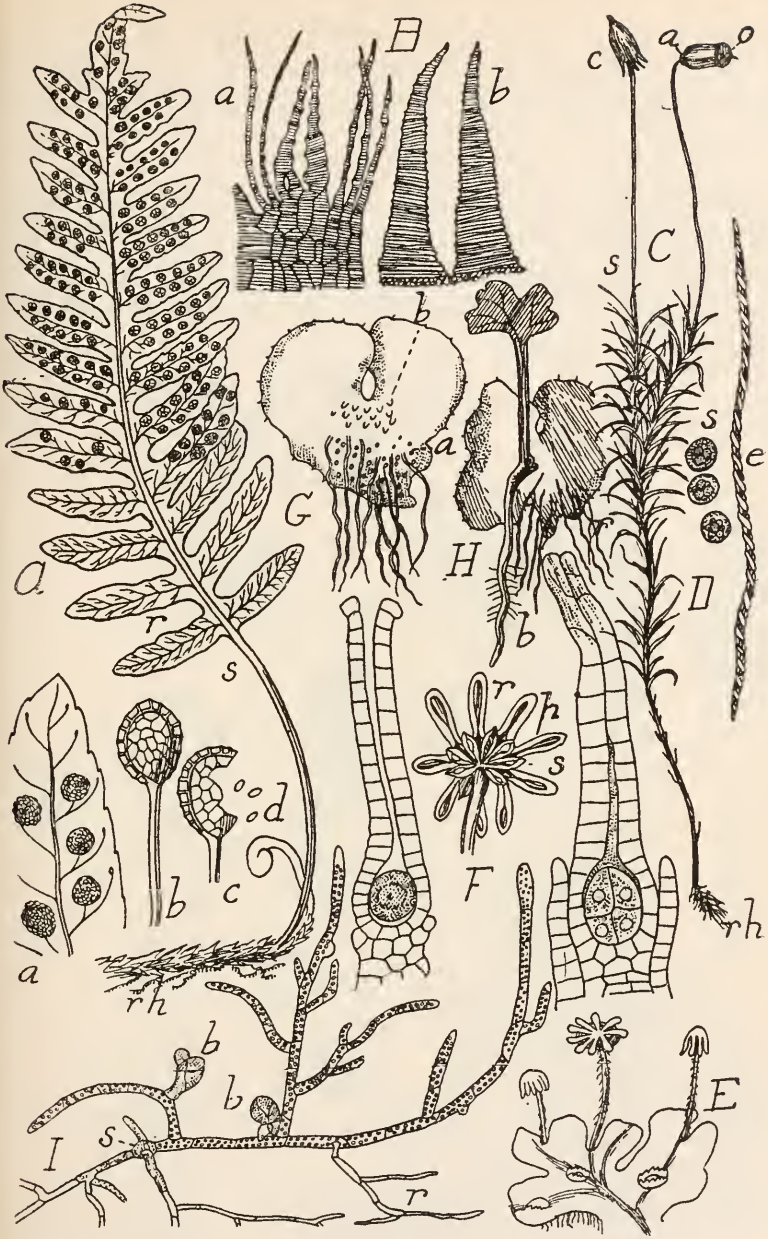

Fig. 116a. *A.* Common Polypody (*Polypodium vulgare*). *rh.* Rhizome. *s.* Stipe. *f.* Frond. *r.* Rachis. *a.* Part of frond with sori. *c.* Sporangium. *d.* Spores. *B.* Moss (*Mnium hornum*). *a.* Inner peristome. *b.* Outer peristome, two teeth. *C.* Juniper Moss (*Polytrichum commune*). *rh.* Rhizoid. *s.* Seta or stalk. *c.* Calyptra or cap. *o.* Operculum. *D.* Common liverwort (*Marchantia polymorpha*). *s.* Spores. *e.* Elater. *E.* Same as *D*—thalloid body with female fruiting body and cupules. *F.* Same more magnified. *r.* Rays with the spore cases containing the spores and elaters. *p.* Perigynium, to the left and right archegonia, different stages. *G.* Prothallus of fern with archegonia, *b.* and antheridia, *a.* *H.* Fern prothallus with young fern and root at *r.* *I.* Protonema of Moss (*Funaria hygrometrica*). *r.* Rhizoids. *b.* Buds. *s.* Spores.

is brought about. After fertilization, the egg cell divides and gives rise to an embryo. The mosses differ from the ferns and their allies in a less differentiation of tissues and a slight development of shoot and root system. The vascular system and leafy shoots and roots are marked in the ferns.

PTERIDOPHYTA

Spores alike or unlike microspores and megaspores developing into flat or irregular prothallia; these bear the reproductive organs, (antheridia and archegonia); flowers and seeds absent; usually a well developed vascular system.

This sub-division includes the class *Filicales* or ferns proper. The class *Equisetales* or horsetails; the *Lycopodiales* represented by the common club moss, (*Lycopodium*).

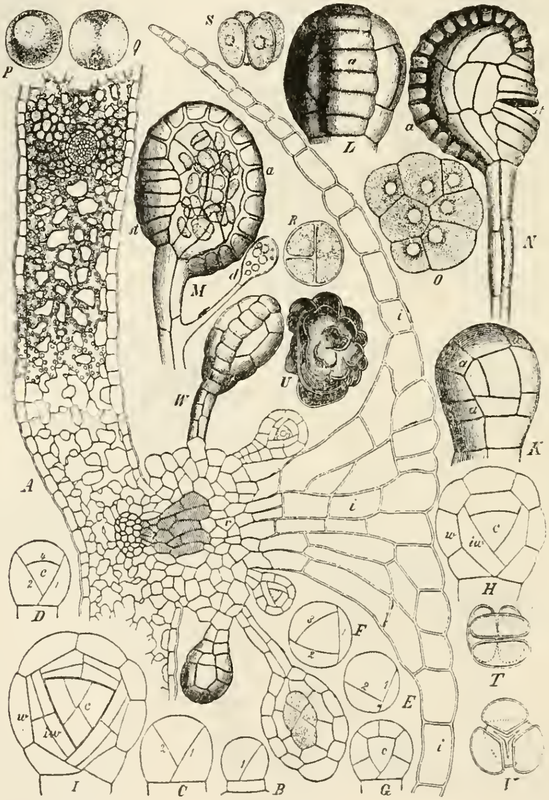

Fig. 116b. Fern. *A*. Section through frond of *Aspidium Filix mas*, a leaf-like body with parenchyma cells, an epidermis and vascular bundles x 100. *B-J*. Development of the sporangia of *Aspidium trifoliatum* x 350. *K*. Young sporangium of *Nephrolepis exaltata* in the act of differentiating the annulus x 350. *L*. Immature sporangium of *Blechnum occidentale*, seen from the back. *M*. Sporangium with spores. *N*. Sporangium dehiscence at *st*, *a* jointed ring x 120. *O*. Group of spore mother-cells x 350. *P-R*. Single spore mother-cells in different stages of partition x 425. *S,T*. Bilateral tetrads of *Aspidium Filix mas*. *U*. Mature spores of *Aspidium Filix mas* x 500. *V*. Tetrads. After Luerssen.

FILICALES

Leafy plants, fronds usually raised on a stipe; coming from a rootstock; leaves usually rolled up in the bud, circinate; spores all of one kind and size, produced in sporangia which occur on the back of the frond, these at maturity break open and discharge the minute spores, which develop prothalli that bear the antheridia and archegonia. The following sub-orders occur in the United States: the Ophioglossaceae represented by the common adder's tongue, *Ophioglossum vulgatum*, found in moist meadows, the Moonwort, *Botrychium Lunaria* and *B. Virginianum*; the Osmundaceae, large ferns with straight erect rootstocks, pinnate leaves; large globose sporangia with mere traces of a ring; the Royal fern, *Osmunda regalis*, Clayton's fern (*O. Claytonia*), the most common species in damp woods, and the Cinnamon Fern (*O. cinnamomea*), occurring in wet places, marshes, etc.; the Filmy ferns, Hymenophyllaceae, represented by the Bristle Fern (*Trichomanes radicans*); Cyatheaceae with such tree ferns as *Dicksonia*; Polypodiaceae, Common Brake, Maidenhair fern;

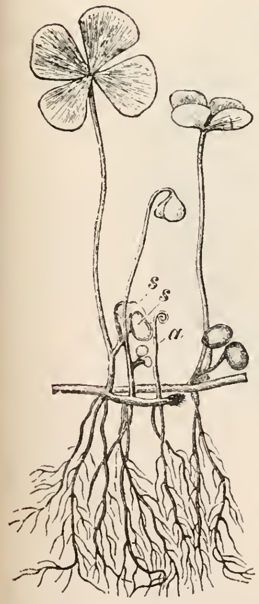

Fig. 117. Marsilia (*M. quadrifolia*), a young leaf. *s*. Fruiting body. Bischoff.

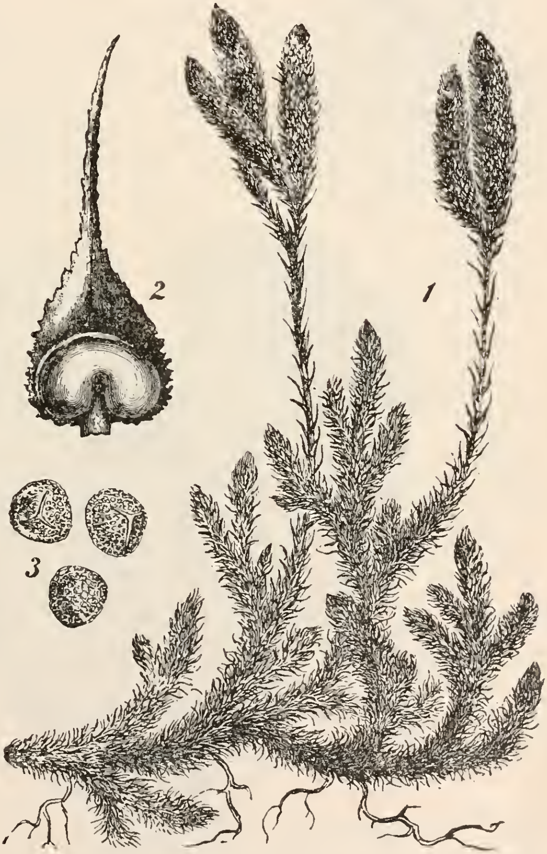

Fig. 117a. Club moss (*Lycopodium clavatum*). 1. Plant with fertile shoots. 2. Scale and the sporangium. 3. Spores. After Wossidlo.

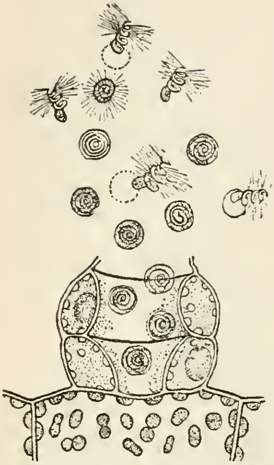

Fig. 118a. Antheridium of fern with sperm cells. After Luerssen.

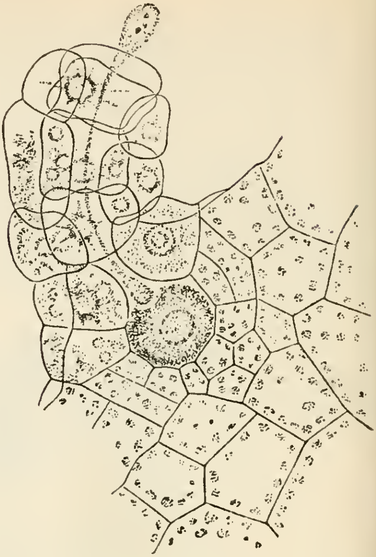

Fig. 119. *Pteris serrulata.* A single archegonium; canal and neck cells; mucilage protruding x 350. After Strasburger.

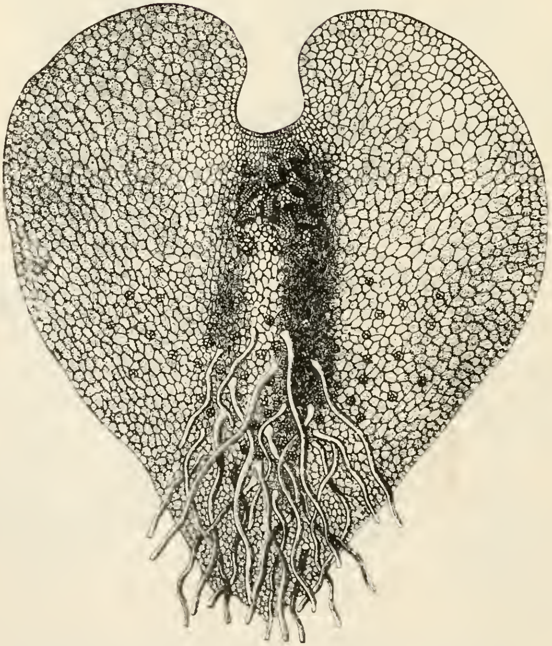

Fig. 120. Prothallus of Fern. Archegonia above, antheridia below among the hairs. After Luerssen.

Gleicheniaceae, some tropical ferns of few species; the Schizeaceae represented by the Small Curly Grass (*Schizaea pusilla*), Climbing Fern, (*Lygodium palmatum*), sporangia ovoid or sessile provided with an apical ring, a family containing about 100 species; the Polypodiaceae the largest sub-order with 200 genera and 3000 species; Marsiliaceae containing Marsilia a common aquatic or semi-aquatic plant; represented by Salvinia, Azolla, also aquatic. The order *Marattiales,* contains the Marattia, tropical.

It is not at all strange that the ferns should be poisonous since Greshoff and others have reported the presence of hydrocyanic acid in these plants. Greshoff says the odor of oil of bitter almonds is especially intense in the young leaves of *Cystopteris fragilis* Bernh; and there is also a trace of HCN in the spores. He also calls attention to the presence of the same substance in the common brake (*Pteris aquilina*), and states that several tropical ferns namely *Davallia braziliensis,* and other species are cyanogenetic, and that one fern, the *D. pentaphylla,* forms a large amount of this substance, especially the cultivated form *elegantissima.* Several species of the *Gleichenia* contain saponin.

POLYPODIACEAE

Perennial with horizontal erect, short or elongated rootstocks; leaves various, entire, pinnate, pinnatifid, or decompound, vernation circinate (coiled); sori on the margins of the leaf or on the lower side, generally without an indusium (covering); sporangia with a vertical many celled incomplete ring, which on straightening out ruptures and discharges the spores. A few of the ferns, as Male Shield fern *Aspidium Filix-mas,* and the *A. marginale,* are used in medicine.

KEY FOR THE GENERA

Indusium absent ....Polypodium
Indusium present, evident.
    Sori marginal.
            Indusium with margin of frond rolled over.
        Sporangia borne on a continuous marginal vein-like receptacle.
        Stipe light colored ....Pteris
        Sporangia on the ends of the veins. Stipe black............Adiantum
    Sori on back with special indusium covering the same.
    Sori linear or oblong......................................Asplenium
    Sori roundish on the back or rarely the apex of the vein.
        Stipe not articulated.
            Indusium flat or slightly convex or round reniform, fixed by the center, opening all round the margin...............Aspidium
            Indusium convex, fixed by a broad base, commonly reflexed as the sporangia ripen.................................Cystopteris
Indusium obscure, leaves closely rolled together with necklace-like segments .... Onoclea

Polypodium. L. Polypody

Simple or pinnate fronds from horizontal rootstocks; stipes articulated to the rootstocks; sori (fruit dots) round, naked on the back of the frond in one or more rows each side of the midrib or scattered; indusium wanting. About 350 species, mostly tropical. The species in the Northern United States are *P. vulgare,* and *P. incanum,* the *P. vulgare* being more common northward. The *P. aureum* found in Florida is a large fern.

Polypodium vulgare. L. Common Polypody

Creeping rootstocks covered with cinnamon-colored scales; stipes light colored; fronds 4-10 inches high, simple and deeply pinnatifid, the divisions linear oblong, obtuse or somewhat acute obscurely toothed; sori large.

Distribution. Throughout North America, also Europe and Asia.

Poisonous properties. Used in catarrh and asthma. Supposed by some writers to be poisonous.

Adiantum L.

Sori marginal, borne on the under side of a transversely oblong, crescent-shaped or roundish, margin of the frond; the sporangia attached to the tips of the forking branched veins; stipe black, polished; leaves divided. About 80 species of wide distribution. The *A. Capillus-Veneris* in tropical and subtropical regions.

Adiantum pedatum. L. Maidenhair Fern

Root-stock slender, chaffy; stipe black, shining, dichotomously forked at the summit; pinnae arising from the upper sides of two branches of the stipe; pinnules short-stalked, numerous.

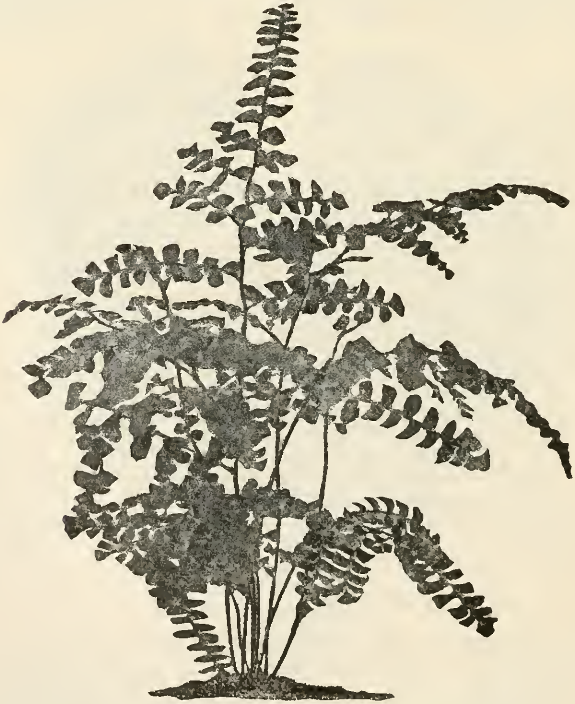

Fig. 121. Cultivated. Maiden hair fern (*Adiantum*).

Distribution. In moist woods from Nova Scotia to British Columbia and Alaska, California, Utah, Arkansas and Georgia, also found in Asia.

Medicinal properties. The Maidenhair Fern has a bitterish aromatic taste and was formerly much used as a demulcent; it is probably poisonous. The European *A. Capillus-Veneris* was used in catarrhal affections.

Pteris

Fronds once to twice pinnate, coming from a stout root-stock, usually large plants; sporangia in a continuous slender line occupying the entire margin of the fern frond and covered by the narrow edge which forms a continuous membranaceous indusium. Pteris and Pteridium are usually separated; about 100 species in the genus *Pteris.*

Pteris aquilina, L. Common Brake

Frond dull green, from 2-3 feet high, ternate at the summit of an erect stout stalk; variable in height from 1-6 feet.; stipe coming from a black root-stock; the spreading branches twice pinnate, branches oblong-lanceolate.

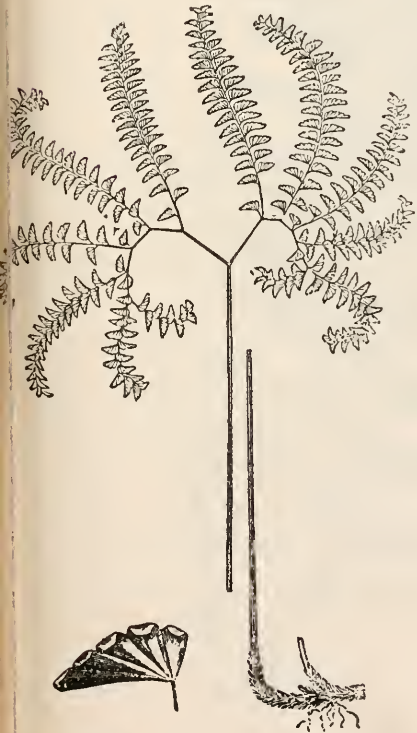

Fig. 121a. Maiden fern (*Adiantum pedatum*). (A. Agriculturist).

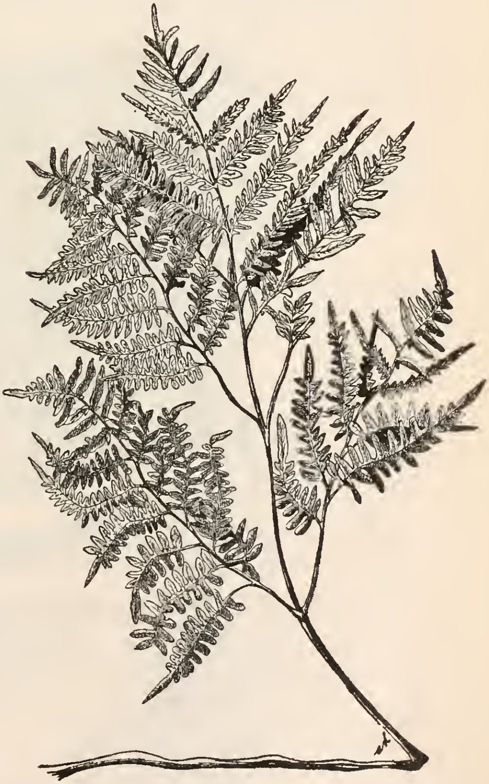

Fig. 121b. Brake (*Pteris aquilina*). The roots and stems of this plant are poisonous. The rootstocks contain a starch which is sometimes used as food. (Ada Hayden).

Distribution. Widely distributed in North America, from the Atlantic to the Pacific coast, also found in Europe. Probably the most common fern in the north, especially on the Pacific coast.

Poisonous properties. This plant has been reported as being an anthelmintic and also an astringent; it is suspected of being poisonous.

Asplenium. L. Spleenwort

Large or small ferns with entire, lobed, pinnate, leaves, 2-3 times pinnate or pinnatifid, veins free; sori oblong or linear, oblique, straight or rarely curved; indusium straight or curved. About 200 species of wide distribution, several species cosmopolitan like *A. Trichomanes.*

Asplenium Filix-foemina. (L.) Bernh. Common Spleenwort

Fronds 1-3 feet high, ovate-oblong or broadly lanceolate, twice pinnate; pinnules confluent on the secondary rachis, oblong and doubly serrate or pinnately incised; sori short.

Distribution. Common in the north and especially in the dense woods, as far south as Missouri.

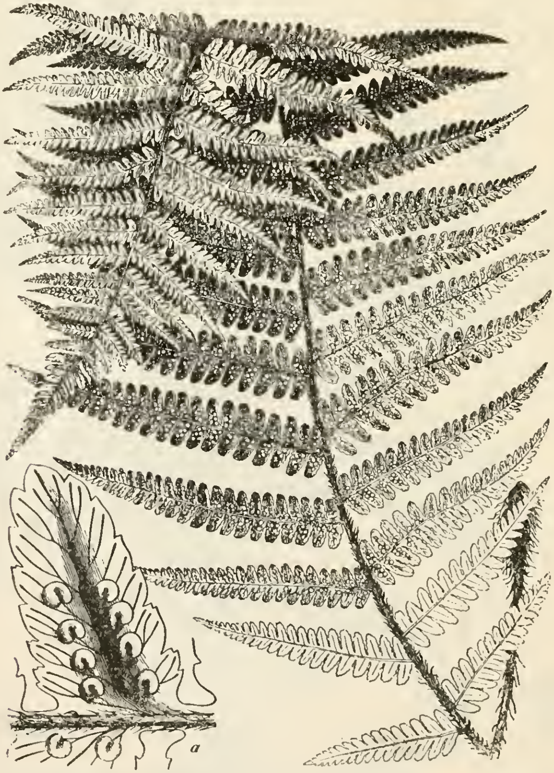

Fig. 122. *Aspidium Filix mas.* Spore bearing leaf 1/6 natural size. *a.* A single segment showing the under side x 10. After Luerssen.

Poisonous properties. The rhizome of the root is used in medicine although it is not officinal. It is supposel to possess properties the same as the Male Shield Fern.

Aspidium. Swartz. Wood Fern

Fronds with 1-3 pinnate leaves, free veins; sori borne on the back or rarely at the apex of the veins; indusium covering the sporangia, flat or flattish, scarious, orbicular and peltate at the center, or round-kidney-shaped, opening all round the margin. About 200 species of wide distribution, common in the northern states.

Aspidium fragrans. (L.) Swartz

Fronds 4-12 inches high, glandular and aromatic, fragrant; rootstock stout, nearly erect, densely chaffy, as are the crowded stipes and rachis. Species found in Asia and Europe.

Aspidium Filix-mas. (L.) Swartz

Fronds large, 1-3 feet high; pinnae linear-lanceolate, tapering from base to the apex; pinnules very obtuse, serrate at the apex and obscurely so at the sides, the basal incisely lobed; sporangia nearer the midvein than the margin and usually confined to the lower half of each fertile pinnule.

Distribution. Native to Europe and found in rocky woods from Labrador to Alaska, northern Michigan, British Columbia, Greenland, Europe, Asia, and the Andes of South America.

Poisonous properties. It is suspected of being poisonous. The rootstocks have long been used in medicine as a vermifuge and contain the following substances: a fatty, green oil, traces of a volatile oil, resin, tannin, filicic acid, $C_{35}H_{42}O_{13}$, filicin, aspidin, $C_{23}H_{27}O_7$, a fixed poisonous oil.

Dr. Winslow says:

> Large quantities of the drug cause hemorrhagic gastro-enteritis, tremors, weakness, stupor, coma, acute nephritis and cystitis. Six drachms of the oleoresin have proved fatal in man and sheep; five drachms in a medium-sized dog; and three ounces in a cow. Aspidium should never be given with oil which aids its absorption.

Aspidium marginale. (L.) Swartz

Much like the preceding, with evergreen fronds, small, thickish, ovate or oblong in outline, and from 1-3 feet high; pinnae lanceolate, acuminate; pinnules oblong or oblong-scythe-shaped, obtuse or pointed, entire or crenately-toothed; sori close to the margin.

Distribution. From Canada to Minnesota, Iowa, Missouri, Arkansas, and Georgia.

Poisonous properties. Probably has the same effect as the preceding species. Dr. Johnson says:

> Oleo-resin of male-fern is one of the best known remedies for tapeworm, and also one of the most efficient. Doubtless much of the disappointment experienced with it is attributable to inefficient preparations. Since, however, it has been demonstrated that *A. marginale* is quite as efficient, and as this species is very abundant, there is now no good reason why reliable preparations should not be the rule rather than, as heretofore, the exception.

Cystopteris. Bernhardi. Bladder Fern

Fronds growing in tufts, 2-3 times pinnate, the lobes cut toothed; stipe slender, 2-4 pinnate leaves; sori roundish, borne on the back of the veins.

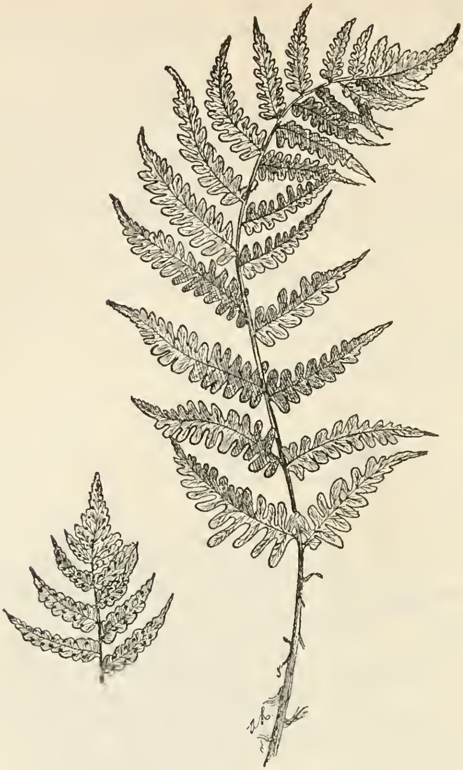

Fig. 123. Shield Fern (*Aspidium marignale*). Said to contain filicic acid. Known to be poisonous. (Ada Hayden).

Indusium delicate arched or level-like, attached by a broad base on the inner, partly under the sorus, opening free at the other side; veins free. A small genus of 5 species, 2 common in the United States. *C. bulbifera,* long slender fronds bearing bulblets which propagate the plant. *C. fragilis,* with brittle stalk, the pinnae and pinnules ovate, lanceolate, irregularly pinnatifid or cut-toothed.

Onoclea. L. Sensitive Fern

Coarse ferns, creeping root stocks, fertile fronds erect, rigid with contracted pod-like or berry-like divisions, rolled up; sori roundish, imperfectly covered by a very delicate hood-shaped indusium attached to the base of the receptacle; when dry opening, allowing the spores to escape; sterile fronds foliaceous. A small genus of a few species.

Onoclea sensibilis. L. Sensitive Fern

Slender root stock with scattered fronds, sterile long stalked 2-15 inches high, triangular ovate, fertile fronds, contracted closely, bipinnate, pinnules rolled up into berry-like bodies.

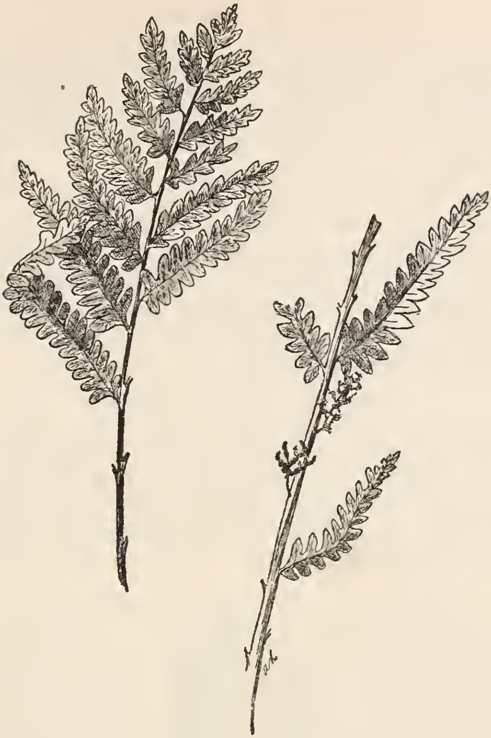

Fig.- 124. Flowering Fern (*Osmunda Claytoniana*). Reported as poisonous. (Ada Hayden).

Distribution. Moist meadows and thickets from Newfoundland to Florida and Minnesota.

Poisonous properties. Very abundant in hay from low meadows. May be injurious.

Onoclea Struthiopteris. (L.) Hoffman. Ostrich Fern

Fronds growing in a crown; root stocks stoloniferous; sterile, short stalked, 2-10 feet high, broadly lanceolate; pinnae pinnatifid, veins free, the veinlets simple; fertile frond shorter, pinnate with pod-like or somewhat necklace-shaped pinnae.

Distribution. Nova Scotia to Illinois, Wisconsin, Iowa and British Columbia, common also in Europe and Asia.

OSMUNDACEAE

Large ferns, root stocks frequently stout and erect; leaves 1-2 pinnate, coiled in vernation; veins free, mostly forked, running to the margins of the pinnules or lobes; sporangia large, globose with mere traces of a ring, or none, borne on contracted pinnae, on the lower surface of the pinnules. Three genera.

Osmunda. L. Flowering Fern

Tall ferns growing in swamps or low ground. Fertile fronds much contracted and bearing on the margins the short pedicelled, naked sporangia on the margins of their radii like divisions without chlorphyll; sporangia thin, reticulated, opening by a longitudinal cleft into two halves, with a few thickened cells the rudiment of the ring.

There are six species in the North temperate regions, three species common in the North, the Cinnamon Fern (*O. cinnamomea*), clothed with rusty wool; the Royal Fern (*O. regalis*), a smooth pale green fern, 2-5 feet high, with 13-25 sterile pinnules; Clayton's Fern (*O. Claytoniana*), clothed with loose wool, but soon smooth; pinnae oblong lanceolate; some of the middle pinnae fertile. The *O. regalis* is used as a tonic and styptic. By some these ferns are regarded as injurious to stock.

EQUISETALES. Horsetails

Rush-like perennial plants, epidermis impregnated with silica; creeping rootstocks, stem generally hollow jointed, simple or branched, striated or grooved, provided with a double series of cavities and usually a large central one, branches verticillate; leaves reduced to a sheath which is divided into teeth corresponding to the principal ridges of the stem; stomata in furrows:

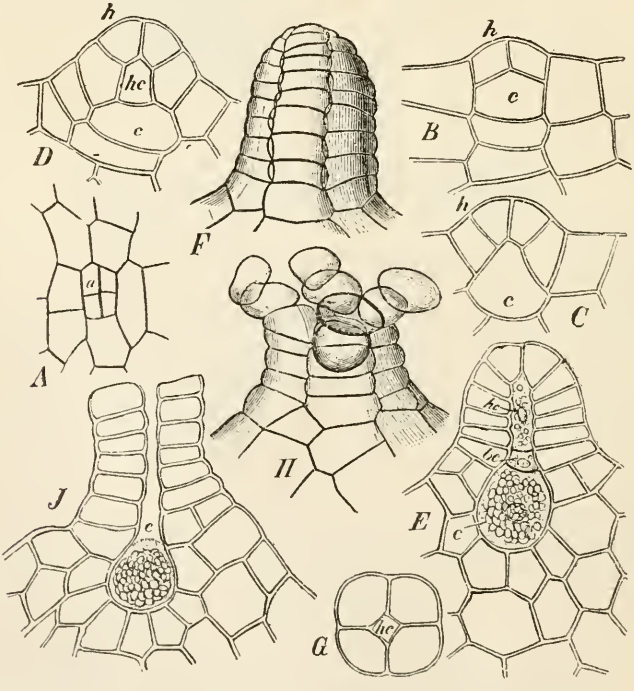

Fig. 125. Formation of Archegonia of *Osmunda*. *A*. Early development seen from the surface. *B*. The same in vertical section. *C-E*. Farther development. *F*. Opened and closed neck. *G*. Neck in oblique section. *J*. Fertilization of the mature archegonium. *a*. archegonium, *h*. neck of the same, *c*. central cell, *e*. egg, *bc*. spermatozoids, *hc*. neck canal cells. *B-J* x 240. *A*. greatly magnified. After Luerssen.

sporangia 1-celled clustered underneath the shield-shaped scale of the cone; spores all alike, two thread-like elastic filaments (elaters) are attached to the base of the spore which roll around it when moist and spreading when ripe; prothallus green formed upon damp ground, usually dioecious. One order, *Equisetaceae,* and one genus, consisting of 40 species. Fossil horsetails numerous.

EQUISETACEAE

Equisetum. L. Horsetail

Perennial jointed plants with creeping root-stocks, dull and blackish in color, often bearing tubers, roots in whorls from the nodes, stems usually erect, simple or branched, jointed cylindrical, the surface striated, the stomata occur in grooves either in rows or in bands, the nodes bearing a whorl of reduced leaves joined by their edges into cylindrical sheaths, the tips consist of presistent or deciduous teeth; branches when present in the form of whorls from the nodes; fruit consisting of a terminal cone containing the sporangia in which occur the greenish spores; each spore provided with four hygroscopic bands, the elaters; spores produce two kind of prothalli, one male the other female; the male containing the antheridia, the female the archegonia. A small genus commonly called rushes or horsetails. Some ten species in eastern North America.

Equisetum arvense. L. Common Horsetail

Perennial with annual stems, stomata scattered; fertile stems unbranched, destitute of chlorophyll, 4-10 inches high, soon perishing; sheaths distant, 8-12 toothed; the sterile slender 1-2 feet high, 10-14 furrowed producing simple or sparingly branched, 4-angular teeth, herbaceous, triangular lanceolate.

Distribution. Abundant in sandy fields along roadsides and railroads, especially northward from Newfoundland to Virginia, California and Alaska. Also occurs in Europe and Asia.

Equisetum hyemale. L. Scouring Rush

Stems all alike, slender, rather stiff, evergreen, from 1½-4 feet high, 8-34 grooved. Stem rarely producing branches which are usually short and sometimes fertile; stomata arranged in rows, rough ridges with 2 indistinct lines of tubercles, the central cavity large, sheath rather long, cylindrical, marked with a black girdle, their ridge obscurely carinate; spikes persistent.

Equisetum hyemale. L. var. *robustum,* (A. Br.) A. A. Eaton

Stem perennial, tall and stout, 8-10 feet high, sometimes an inch thick, occasionally branched; 20-48-grooved, the ridges roughened with lines of transversely-oblong tubercles; sheaths rather short with a thick girdle at the base and a black limb; ridges of sheaths carinate.

Distribution. In wet places, from Ohio, Iowa, to Louisiana, Mexico, California, and British Columbia, also in Asia.

Poisonous properties. The rushes have long been recognized in Europe as being injurious to horses, and there are records of their poisonous properties in American Agricultural Literature.

A writer in the American Agriculturist, many years ago, described accurately a disease which might be called equisetosis, and which was produced by poisoning from these rushes.

Mr. H. Lawrence of Spencer, Iowa, recently sent me a specimen of the last species mentioned above, writing that:

"The cattle staggered and had the scours. One man lost 10 head of young animals."

Friedberger and Fröhner state that the symptoms of poisoning by this rush are as follows:

At first, excitement and anxiety; the sensorium remaining unaffected; later, uncertainty of movement, reeling and staggering; at least, paralysis of hinder limbs, tumbling down, general paralysis, insensibility to external irritants, unconsciousness and coma. Pulse accelerated, appetite at first normal, but in course of time great disturbance of nutrition; sugar in the urine. Course sometimes very acute, death occurring in a few hours, but sometimes protracted (two to eight days), and at times chronic (one to several weeks). In cattle, after excessive eating continuous diarrhoea becomes a prominent characteristic along with the paralytic symptoms; while, if the food be persisted with, cachexia and hydraemiea, combined with weakness bordering on paralysis, make their appearance, Autopsy reveals: hyperaemia, oedema, dropsical effusions on the brain and spinal cord, especially on cerebellum; in cases of longer duration, hydraemia. Sometimes inflammatory changes in the mucous membrane of stomach and bowels. Therapeutics: change of fodder, purgatives and stimulants, especially camphor; blisters along the spine.

Mr. P. J. O'Gara says of this plant:

It has been found growing along roadsides and railroad tracks, but its occurrence in serious amounts is apparently confined to low moist meadows which are more or less sandy. As before indicated, it is confined mostly to the Missouri bottom. A thorough examination of several meadows in this region has shown that this plant often constitutes one-sixth or more of the bulk of the hay. There is no doubt that this plant causes a great deal of trouble, but to what extent is not known as many of the haystacks which were carefully examined contained the Rattle-box in considerable amount. Horses eating this hay suffered the combined effects of both poisonous plants.

Prof. Jones and Dr. Rich state:

The first evidence of the trouble is more or less unthriftiness, the horse appearing thin and the muscles wasted. In from two to five weeks, according to the age of the horse and the manner of feeding, the animal begins to lose control of its muscles, sways and staggers like a drunken man, although its eye looks bright, it eats well, and may even try to caper and play. After muscular symptoms become pronounced many cases refuse to lie down, standing until thrown down by disorderly muscular contractions. If it continues to eat the plant the horse in any case soon loses power to stand and goes down, after which it becomes very nervous and struggles violently to get up, the legs become more or less rigid, and at times all the muscles of the body seem convulsed. Even in this condition one well nursed patient lived two weeks. The horses are generally willing to eat, although unable to rise, but become sore and tired from struggling, finally dying from exhaustion. Life is much prolonged by turning from side to side three or four times in twenty-four hours; thus preventing gravitation congestion of the lungs and kidneys. The pulse becomes slow until toward the end when it is rapid and weak. Temperature is below normal until the animal goes down, after which some fever develops in consequence of the nervous excitement and violent struggling. The extremities are usually cold, and in the winter horses suffering from Equisetum poisoning suffer severely from the cold, presumedly because of diminished oxidation and consequent low body temperature. The visible lining membranes of mouth, nose, eye, etc., become pale.

Conditions Influencing the Effect of the Poison.

Age of the horses.—Young animals develop symptoms much more quickly and succumb to the Equisetum poisoning sooner than older ones. In one case under observation a mare eating Equisetum hay did not show symptoms until after four weeks, while her colt by her side developed typical symptoms of horsetail poisoning and died in ten days. Nine out of fourteen horses on one farm, all fed alike upon good hay, were bedded with swale hay containing large quantities of this weed. They ate this bedding freely and within three weeks all nine showed symptoms of poisoning, the remaining five bedded with straw kept perfectly well. The youngest, a three-year-old, was down and died a few days later. The oldest, an old brood mare, showed but slight symptoms, while the other seven, of intermediate ages, all staggered and reeled, although they recovered.

Feed.—Grain-fed horses resist the action of the poison much longer than those not grained. Horses seem to develop a depraved appetite for the weed. In the last mentioned

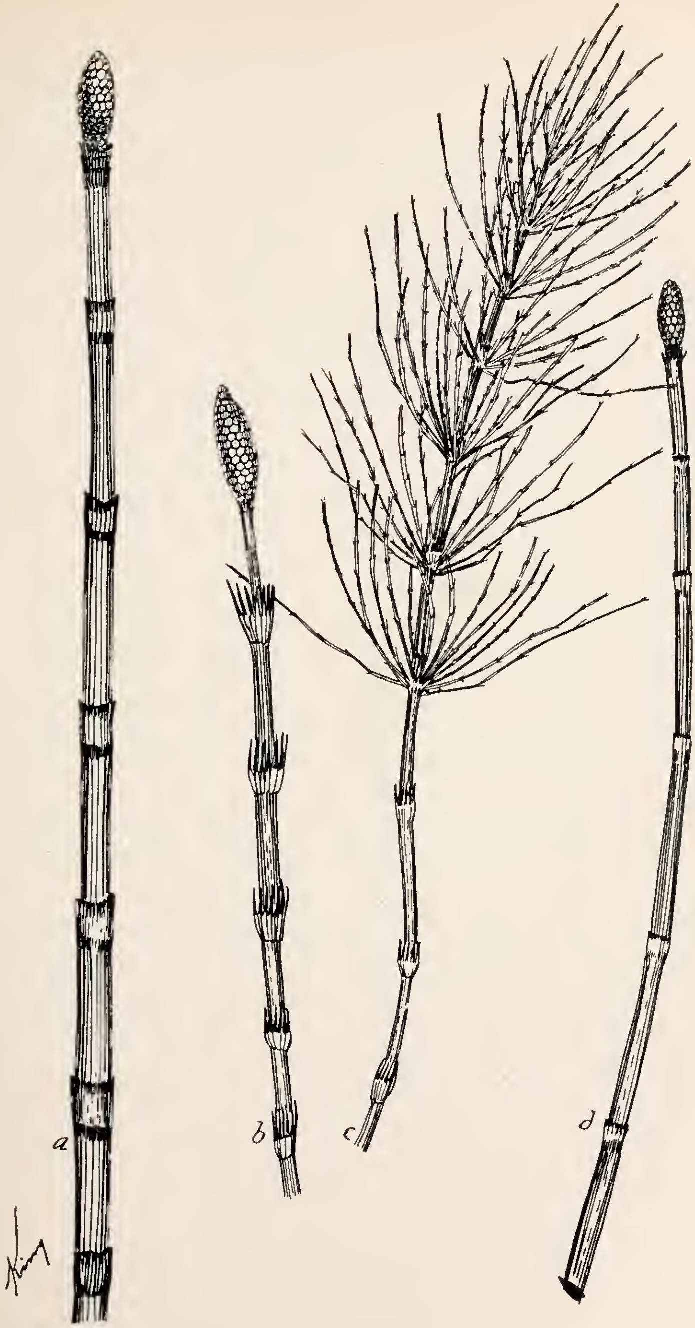

Fig. 125a. a. Scouring Rush (*Equisetum hyemale* var *robustum*); b. Horsetail (*E. arvense*), futile branch; c. Sterile branch of *E. arvense*; d. *E. hyemale*. Said to be poisonous to horses. (C. M. King).

case, though all were fed good, clean timothy hay, they seemed to prefer the horsetail bedding, and even left their grain to eat it.

Condition of the plant.—We have no evidence that horses grazing upon the green plant are poisoned thereby. It may be that the plant is less poisonous in the early stages of its growth than when mature, or the laxative effect of the grass eaten with it may prevent the cumulative action of the poison. Moveover the plant rarely occurs in as large quantities in pastures as in meadows and apparently rarely need cause apprehension. If, however, it is abundant, close watch should be kept upon horses pasturing where it occurs that the animals may be removed at the earliest symptoms of trouble.

Treatment.—In the way of treatment, the first and most important thing is to stop immediately the feeding of the Equisetum hay. Our practice further than this has been to give a purgative pill consisting of one ounce of Barbadoes aloes, one or two drachms of ginger, and sufficient English crown soap—soft soap—to make a ball or pill. This is put down the horse's throat, at one dose, and following this we have usually given bran mashes night and morning until the digestive tract is entirely cleared of the poisonous plant. In case aloes cannot be easily obtained a quart of raw linseed oil will be very well. After the physic has operated, a teaspoonful of powdered nux vomica is added to each grain feed, three times a day. This tends to relieve the muscular incoordination. When poison symptoms are severe and especially when staggering is very profound, slings should be used to support the animal for when once down it is very difficult to make it stand again even with the aid of slings. If, however, the above treatment is begun before the horse loses the power to stand and it can be kept on its feet, its life can be saved in practically all cases.

Stebler & Schröter in their work on the weeds of meadows mention this same plant and several other species as being injurious to stock, not only to horses, about which there is a difference of opinions, but to cattle. In the latter it produces diarrhoea. Cows become poor and the milk flow ceases or is checked.

That this disease is similar to one produced by mouldy corn is shown by the following quotation from Dr. Peters:

> It is also known that certain weeds commonly called horsetail have a faculty of producing a disease almost identical with this one. The experiments conducted by Dr. Rich of the Vermont Station show that that weed is capable of producing similar symptoms.

EMBRYOPHYTA, (SIPHONOGAMA, OR SPERMATOPHYTA)

Plants producing seeds which contain an embryo with 1 or more cotyledons, a stem caulicle, a radicle, and a plumule, these parts, occasionally not differentiated before germination; microspores, equivalent to pollen grains borne in microsporangia; ovules (macrosporangia) borne on a modified leaf called the carpel, containing 1 macrospore, equivalent to the embryo sac which develops the minute female prothallium, an archegonium; the egg cell in the embryo sac is fertilized by means of a sperm cell in the pollen tube; the male prothallium generally but slightly developed. The Spermatophyta contain two main divisions based upon the character of the ovules.

GYMNOSPERMAE

Ovules naked, not enclosed in an ovary, attached to scales or wanting; pollen grains develop into the pollen tube; the male prothallium contains the sperm cell and fertilizes the egg cell in the ovule. The Gymnosperms are divided into six classes.

1. Cycadales. These include the *Cycas circinnalis* well known in cultivation, an important plant of the tropics. The *C. media* of Australia produces rickets, a *Macrozamia* causes the same disease. Dr. Stafford states that *C.*

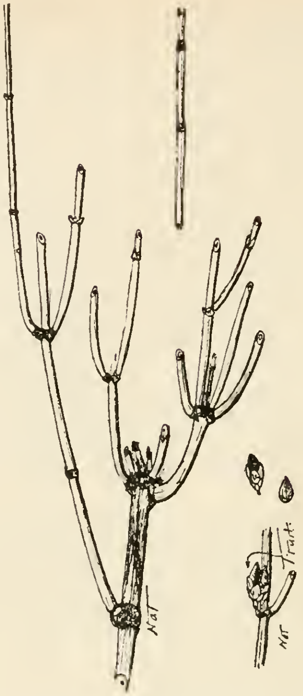

Fig. 126. (*Ephedra nevadense*). A shrub in Southwestern United tSates.

circinnalis, known as the "Fadong" in the island of Guam, is poisonous, but the poisonous properties of the seeds are removed by soaking and repeatedly changing the water. He says also that the seeds when fresh are so poisonous that the water in which they are steeped is fatal to chickens. The group also includes the Dioon the seeds of which furnish a starch which is an article of food. The species of Zamia, a member of this group, are native to tropical Florida.

2. Bennettiales, A fossil group.

3. Cordaitales, A fossil group.

4. Gingkoales. These include the Gingkoaceae, of which the *Ginkgo biloba* is well known and is frequently cultivated as an ornamental plant in the United States. Long avenues of these trees are planted in Washington. The fruit of the Gingko has a very disagreeable odor. The tree was common in the tertiary age.

5. The Coniferae.

6. Gnetales. This group is represented in the United States by Ephedra, shrubs with horse-tail like branches, small leaves and buckwheat-like seeds.

The Welwitschia of the above group is found upon stony ground in the tropical Old World.

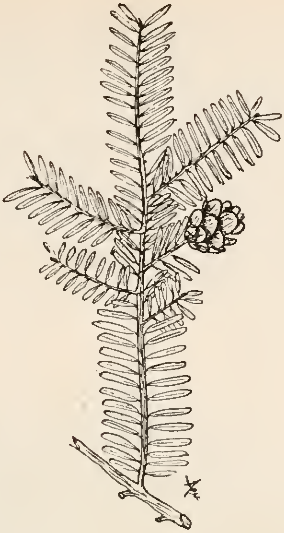

Fig. 127. Hemlock (*Tsuga canadensis*). A common forest tree of Northern North America. Contains resin and the usual principles found in these resins. Said to be injurious.

CONIFERAE

Resinous trees or shrubs generally evergreen leaves, entire or scale-like; wood consists mostly of tracheids marked with large depressed disks; tracheae only present near the pith and in the leaves; perianth none; flowers monoecious; stamens several, together, subtended by a scale; anthers 2-7 celled; pollen grains frequently of three cells, one fertile and two inflated; ovules with two coats, borne solitary or together on the surface of a scale, straight or partly inverted; fruit a cone, usually papery, but in some instances fleshy, sometimes berry-like; seeds winged or wingless; endosperm abundant, fleshy or starchy; embryo straight and slender; cotyledons 2 or more. About 25 genera and between 275 and 300 species. They include the Podocarpus of the tropical regions, the Taxus or Yew, the Norfolk Pine (*Araucaria excelsa* and *A. brasiliana*), frequently cultivated, the White Cedar (*Cupressus Lawsoniana*) of California, the *Cupressus nootkatensis* of the northwest coast, the White Cedar (*C. thyoides*) which occurs in swamps, in the East; the genus Picea consisting of the spruces, Norway Spruce (*P. Engelmannii*), Tideland Spruce (*P. sitchensis*), one of the largest trees in Oregon and Washington; the Douglas Fir (*Pseudotsuga Douglasii*), one of the most valuable of the North American conifers, found in Washington, Oregon and California and in the Rocky Mountains; the Hemlock (*Tsuga canadensis*), abundant in North America, and the source of Canada or Hemlock Pitch, the bark containing an abundance of tannin; the leaves are said to be abortive; the *Tsuga heterophylla* of the Pacific coast which produces a valuable lumber; the Balsam Fir (*Abies balsamea*), which furnishes a kind of balsam that contains four acid resins and a volatile oil; the Black Fir (*Abies concolor*).

a large forest tree of the Pacific coast and the Rocky Mountains; the Sandarac tree (*Callistris quadrivalvis*), which furnishes not only the sandarac gum used in making varnish, but also a dark-colored, fragrant wood capable of high polish and used in ornamental work; the Arbor Vitae, or White Cedar (*Thuja occidentalis*), which contains *fenshoe, thujone, thujin,* and the bitter glucoside *pinicrin,* its leaves being irritating to the skin, sometimes producing blisters; the Norway spruce (*Picea excelsa*), which contains resins and volatile oils and is the source of Burgundy pitch; the Black Spruce (*P. mariana*), from the young branches of which an essence is prepared that is used in the preparation of spruce beer; the White Spruce (*P. canadensis*), which, with the preceding species furnishes much of the wood pulp used in the manufacture of paper; and the Pines.

Taxus. (Tourn.) L. Yew

Flowers generally dioecious or occasionally monoecious, axillary from scaly buds; sessile or nearly sessile, from small staminate catkins of a few scaly bracts; 5-8 stamens; anthers 4-celled; fertile flowers solitary, erect, subtended by a fleshy cup-shaped disk; fruit consisting of a fleshy disk which becomes cup-shaped and red and encloses the bony seed.

Distribution. About 6 species native of the north temperate regions. One upon the Pacific coast, *Taxus brevifolia,* is a tree. The European Yew (*Taxus baccata*), a well known poisonous plant, is frequently used for ornamental purposes in this country.

Taxus canadensis. Willd. American Yew

A low shrub, straggling over bushes, with linear leaves, green on both sides.

Distribution. In the woods from Newfoundland to New Jersey and Virginia, west to Wisconsin, Iowa and Minnesota.

Poisonous properties. One species is known to contain the alkaloid taxin, $C_{37}H_{52}NO_{10}$. Dr. Johnson says, concerning the poisonous properties of the American Yew:

> This plant, a variety, only, of the European yew, cannot be said to have, as yet, a place among medicines. It is believed, however, to possess poisonous properties, and is perhaps worthy of investigation. Regarding the poisonous properties of the berries, the author can state that he has eaten them without deleterious effect, but whether because the quantity was insufficient or not, is an open question. Cases of fatal poisoning from eating the berries of the European yew are on record, and therefore our variety is certainly open to suspicion.

Chesnut refers to the poisonous nature of the yew as follows:

> The common yew, or ground yew of the northeastern United States is called poison hemlock in some places. The leaves of this shrub are probably poisonous to stock, as are those of the European yew. This species is more accessible to stock than are those of the western yew (*Taxus brevifolia*), which grows only in deep canyons.

Dr. Otto Lehmann * in his treatise on poisonous plants, states that older naturalists regarded the yew as one of the most powerful of poisonous plants. Modern testimony is conflicting, but he regards the branches and leaves as poisonous for animals. Friedberger and Fröhner give the symptoms of poisoning from yew as follows: "Death may be sudden, resembling apoplexy; it may be preceded by staggering and convulsions; cases of long standing show gastro-enteritis. Give purgatives as remedies."

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* Giftpflanzen. 121. Hamburg. 1882.

Pinus. (Tourn.) L.

Evergreen trees with short scale-like leaves and longer leaves in bundles; the ordinary foliage leaves linear, in bundles varying from 2-5, rarely 1; stamens in catkins, borne at bases of shoots; filaments short; anthers longitudinally dehiscent; pistillate, bearing aments, solitary or clustered on the twigs of the preceding season consisting of numerous imbricated bracts, each with an ovule-bearing scale; fruit a large cone; seeds 2 at the base of each scale; winged above. About 75 species of wide distribution. Of these the more important are: White Pine (*P. Strobus*), one of the most valuable of North American Pines; Sugar Pine (*P. Lambertiana*) of California and Oregon; Austrian Pine (*P. Laricio*), furnishing Austrian turpentine; the Long-leaved Pine (*P. palustris*) of the South, the most important source of turpentine, which

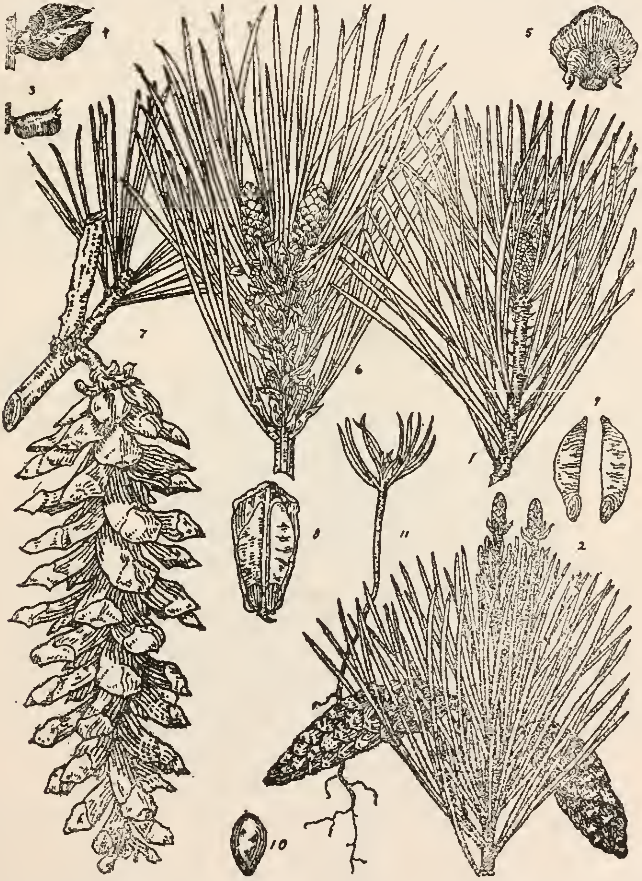


Fig. 128. White Pine (*Pinus Strobus*). 1. Branch bearing staminate flowers. 2. Branch bearing pistillate flowers and young cones. 3. Anther, enlarged. 4,5. Scales of pistillate flower, enlarged. 6. Autumn branch bearing young cones. 7. Fruiting branch with young cone. 8. Scale of cone with seeds attached. 9. Seeds with wings attached. 10. Seeds, enlarged. 11. Seedling plant. 1, 2, 6, 7, 8, 9 one-half natural size. (S. B. Green).

in this tree amounts to 70-80 per cent., resin, 15-30 per cent, volatile oil and some pinene $C_{10}H_{16}$, a very important constituent; *P. sylvestris,* the source of Russian turpentine; *P. pinaster*, supplying the French turpentine; *P. heterophylla* and *P. echinata,* also turpentine trees; Loblolly Pine (*P. Taeda*) also containing *pinene*; the Western Yellow Pine (*P. ponderosa*) occurring from mountains of Colorado westward, a large tree 120 or more feet high, 4 or 5 feet in diameter, branching widely, spreading or drooping, bark light red, leaves in 3's or rarely 2's, cones stout, dense, heavy, ovoid-conical, each scale with short recurved prickle; the variety *scopulorum* of the last named species, found in the front Rockies, a smaller tree with shorter leaves; and Lodge Pole Pine (*Pinus contorta*), a tall straight tree, 80-120 feet high, and from 12 inches to 3 feet in diameter, with conical head, thin, light grayish-brown bark, leaves 1-3 inches long, light green, rigid, often persistent cones. This last named species occurs from Colorado, Wyoming and South Dakota to the Pacific coast and is closely related to the Jack Pine (*P. Banksiana*).

Phenol and creosote oil are obtained from *Pinus palustris* and *P. Taeda.*

Poisonous properties. Cattle and sheep do not usually graze upon the leaves of conifers, but when forced to do so because of scarcity of fodder, sheep will eat the leaves, which may produce injurious symptoms. According to Friedberger and Fröhner, plants containing turpentine are poisonous. Chobert, in 1787, observed gastro-enteritis complicated by nephritis as a result of grazing on leaves of conifers. The first named authors find symptoms of haematuria, constipation, evacuation dry, and irritation of the kidneys.

Juniperus, (Tourn.) L. Juniper

Flowers dioecious or monoecious, in lateral catkins, staminate catkins small, fertile catkins consisting of 3-6 fleshy scales; fruit appearing like a berry; color of fruit bluish-black or blackish, frequently with white bloom; seeds 1-3, wingless and bony. The *J. Oxycedrus* of the Mediterranean region produces "oil of cedar."

Juniperus communis. L. Common Juniper

A shrub or small tree with spreading or pendulous branches; leaves rigid, spreading; berries dark blue. The variety *alpina,* Gaud. is a low, decumbent, or prostrate shrub with shorter, less-spreading leaves. It contains *pinene* and *cadinene.* The oil and fruits are used in the manufacture of gin.

Distribution. From Nova Scotia to British Columbia, to Pennsylvania, Wisconsin, Michigan, Nebraska, and in the Rocky Mountains to New Mexico; occurs also in Europe and Asia. The variety *alpina* is common in the mountains of New Mexico northward, not, however, as widely distributed as the species.

Juniperus virginiana. L. Red Cedar

A shrub or tree extremely valuable, frequently from 60-90 feet high; pyramidal in form; leaves scale-like, obtuse or acutish, dimorphic, the leaves of young plants being more or less flattened, spiny, and awl-shaped, while those of the stem are scale-like and appressed; catkins terminal; berries on straight peduncles; cones light blue or glaucous. The Platte Cedar (*J. scopulorum*) differs from the other in the development of the seeds.

Distribution. The Red Cedar occurs from New Brunswick to British

Columbia, south to Florida, Texas, New Mexico and Arizona, also the West Indies. The Platte Cedar occurs from Nebraska westward and is common in the foothills of the Rockies.

Poisonous properties. According to Dr. Halsted it poisons goats which browse on it.

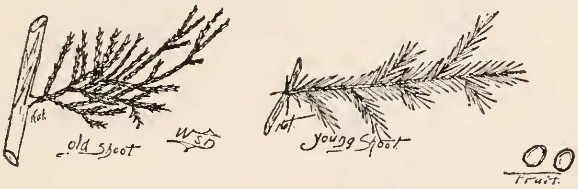


Fig. 129. Red Cedar (*Juniperus virginiana*). To the left a branch from an old tree; to the right juvenile shoots, spiny. The plant is poisonous and injurious.

Juniperus occidentalis. Hooker

A shrub or small tree, with bark in shreds; leaves pale in color, closely appressed, obtuse or acutish; berries 4-5 lines in diameter.

Distribution. Northwest along Pacific Coast.

The variety *monosperma*, Eng., shows stunted trees, frequently 2 or more feet in diameter, attaining an age of 1200-1300 years; leaves scale-like; berries

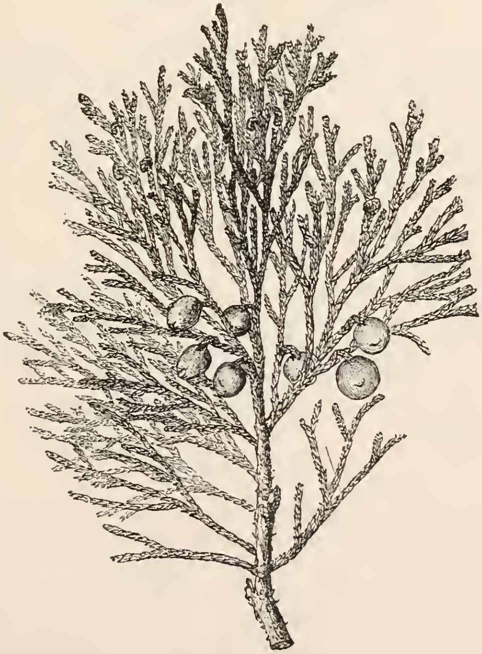


Fig. 130. Savin, Juniper (*Juniperus Sabina*). Fruiting branch. Known to be poisonous. (After Strasburger, Noll, Schenck and Schimper).

smaller than the above, frequently copper-colored; generally with one seed or sometimes more.

Distribution. Found from Colorado to Western Texas, Arizona, California, and Wyoming.

Several allied species have been described, among them *J. Knightii* by Nelson, and another by Sudworth, which occurs in the southwest.

Juniperus Sabina, L. Savin, Juniper, Swedish Juniper

A prostrate shrub with appressed leaves in pairs; margin slightly or indistinctly denticulate; berries on short recurved peduncles; 3-4 lines in diameter, 1-3 seeds. It contains the substance *sabinol.* It is officinal.

Distribution. Along the Atlantic coast, from Massachusetts westward to New York, Minnesota, Montana, and British Columbia, also in Europe and Asia.

Poisonous properties. The wood of Red Cedar is extensively used in the manufacture of lead pencils and was formerly also employed in making cigar boxes. The fruit of the common Low Juniper (*J. communis*) is used for flavoring gin. Red Cedar contains a fragrant volatile oil consisting of *cedrol* and *cedrene.* Cases of poisoning from this genus have been reported.

ANGIOSPERMAE

Ovules enclosed in an ovary.

MONOCOTYLEDONEAE

Embryo with a single cotyledon, first leaves of germinating plantlet alternate; stems endogenous, consisting of an outer part, an inner mass of cells the parenchyma, and the bundles distributed through the mass; no distinction into pith, wood, and bark; leaves generally parallel veined, usually alternate and sheathing at the base; flowers generally on the plan of 3. This group of plants includes the palms, grasses, lilies, duckweeds, etc.

PANDANALES

Marsh plants, herbs or trees with linear leaves; flowers in spikes or heads; perianth of bristles or of chaffy scales; ovary 1, 1-2 celled; endosperm mealy or fleshy. This order includes the Cat-tail (*Typha latifolia*), Screw pine (*Pandanus*), and the Bur-reed (*Sparganium*). The ripe fruit of the *Pandanus fragrans* is used as a relish in the Philippine Islands.

The Cat-tail is reported as poisonous. It is common across the continent and is found in swamps.

HELOBIAE

Aquatic or marsh herbs, leaves various; flowers perfect, monoecious or dioecious; perianth present or absent; stamens 1-numerous; carpels 1 or more, mostly distinct; endosperm none or little. This order includes the Pond Weeds (*Potamogeton*), of which there are many species, which float in the water and often give trouble in ponds of parks; fresh water eel grass (*Vallisneria spiralis*), water weed (*Elodea canadensis*), a troublesome weed in the canals of England and Europe. All of these plants are abundant in our fresh waters and afford food for crustaceans, which in turn are used as food for fish.

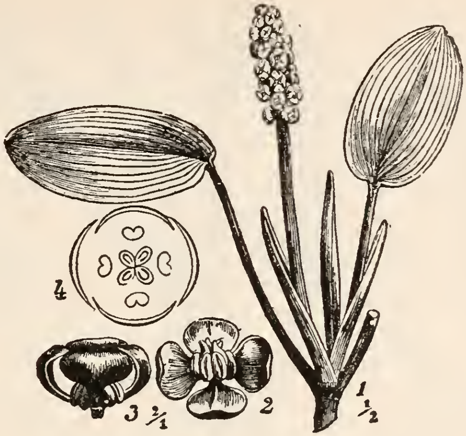


Fig. 131. Pond-weed (*Potamogeton natans*). 1. Apex of flowering shoot. 2. Flower viewed from above. 3. Flower viewed from side. 4. Diagram of flower. (After Wossidlo).

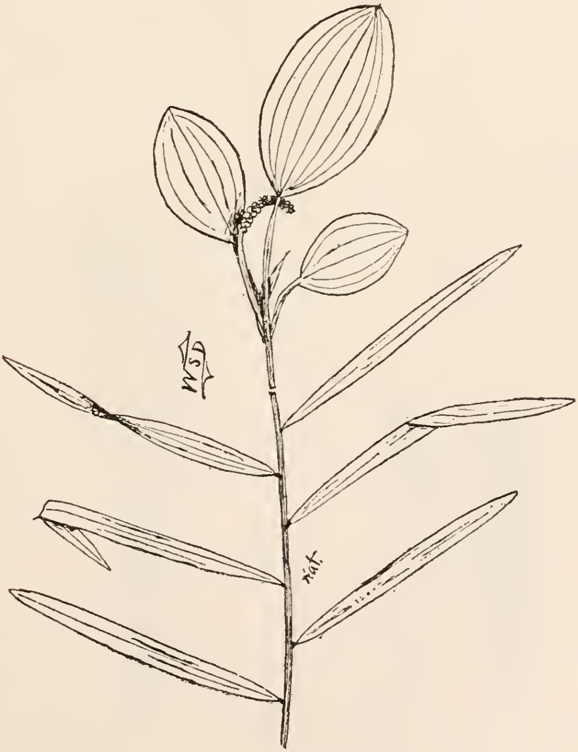


Fig. 132. Pond weed (*Potamogeton*). Common in fresh water ponds.

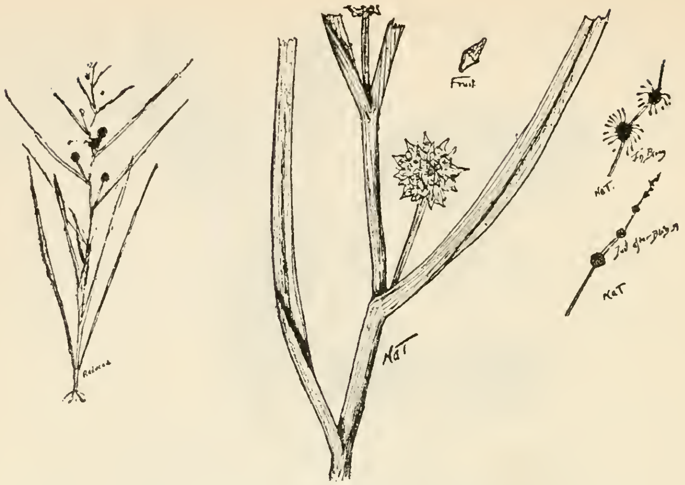


Fig. 133. Bur-reed (*Sparganium*).

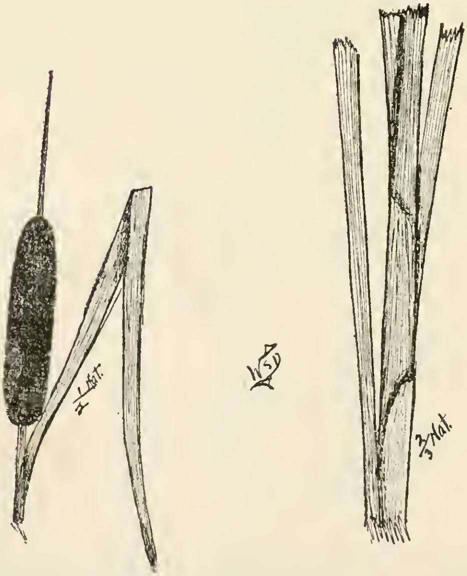

1/2 Nat.
WSD
2/3 Nat.

Fig. 134. Cat-tail (*Typha latifolia*). A common weed along shores of lakes and streams.

ALISMACEAE. D. C. Water-Plantain Family

Aquatic or marsh herbs, generally with smooth, sheathing leaves; flowers perfect, monoecious or dioecious; sepals 3, persistent; petals 3, the larger, deciduous, imbricated in the bud; stamens 6 or more; anthers 2-celled, extrorse; pistils numerous or few, usually with a single ovule in each cell; fruit an achene; seeds small, erect. About 70 species of wide distribution in swamps. The Water Plantain (*Alisma Plantago*) of Europe and North America is common in the northern states. Several species of Arrowheads (*Sagittaria*) are used as food by the Indians and Chinese.

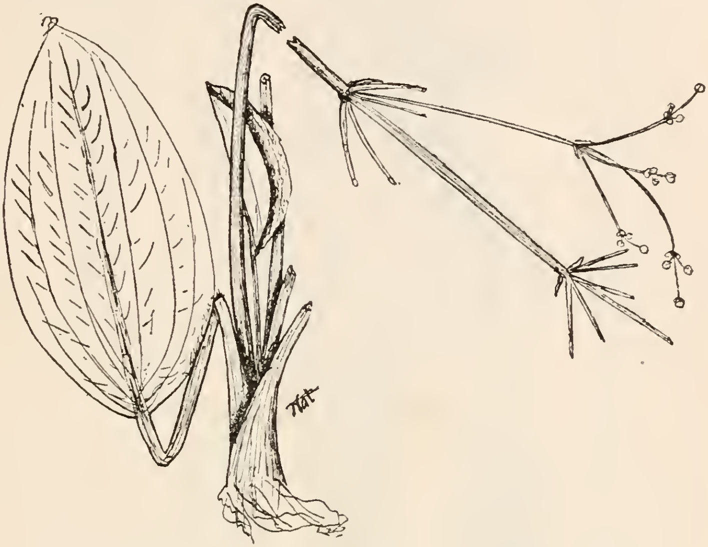


Fig. 135. Water Plantain (*Alisma Plantago*). A common marsh plant.

Sagittaria L. Arrowhead

Perennial with tuber-bearing root stocks and milky juice; basal leaves long-petioled, scape sheathed at the base; flowers monoecious or dioecious, borne near the ground in whorls; sepals persistent in pistillate flowers, reflexed or spreading; petals 3, white, deciduous; stamens indefinite; pistillate flowers with distinct ovaries; ovule solitary; fruit an achene in dense clusters; seed erect, curved.

Sagittaria Engelmanniana, J. G. Sm.

Perennial with stoloniferous roots; leaves very variable; scape 1-4 feet high, angled; lower whorl fertile; pedicel of fertile flowers, at least half the length of the sterile one; filaments smooth; achenes obovate with a long curved or horizontal beak.

Distribution. Across the continent and in Europe.

Poisonous properties. The tuberous stolons are eaten; if there is any poison contained in the raw state it is probably removed by methods of preparation for food.

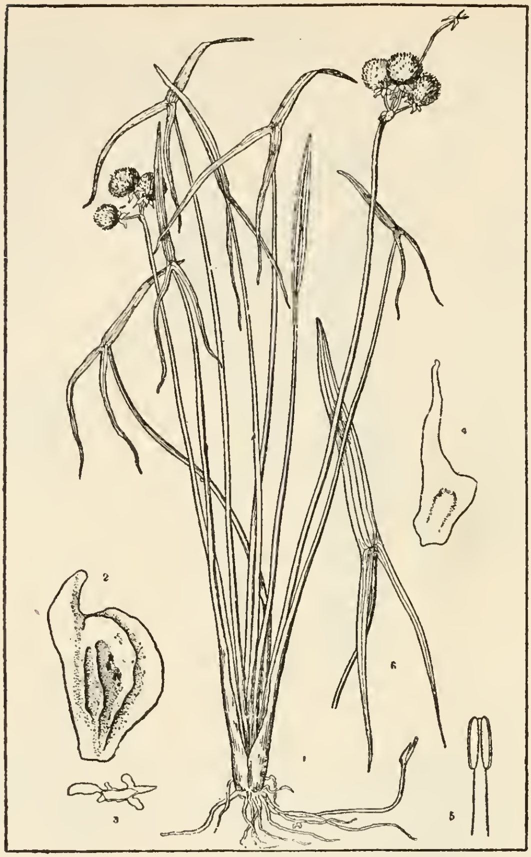


Fig. 136. Arrowhead (*Sagittaria Engelmanniana*). Common in low grounds. Some species supposed to be poisonous. (After Miss G. E. Johnson, Rep. Mo. Bot. Garden).

GLUMIFLORAE

Endogenous plants mostly herbaceous; stems (culms) narrow or without leaves; leaves usually narrow and elongated; entire or serrulate; flowers small, generally perfect, in the axils of dry chaffy scales, called glumes; arranged in spikes or in panicles consisting of spikelets.. 2 families, *Gramineae* and *Cyperaceae.*

Fruit a caryopsis ....1 Gramineae
Fruit an achene ....2 Cyperaceae

I. GRAMINEAE. Grass Family

Fibrous-rooted annuals or perennials, rarely woody, generally with hollow stems; alternate 2-ranked leaves, sheaths split or open on the side opposite the blade; flowers consisting of 2-ranked glumes, forming a 1-many-flowered spikelet; flowering glumes enclosing a small bract called the palet; stamens 1-6, usually 3; anthers versatile, 2-celled, stigma hairy.

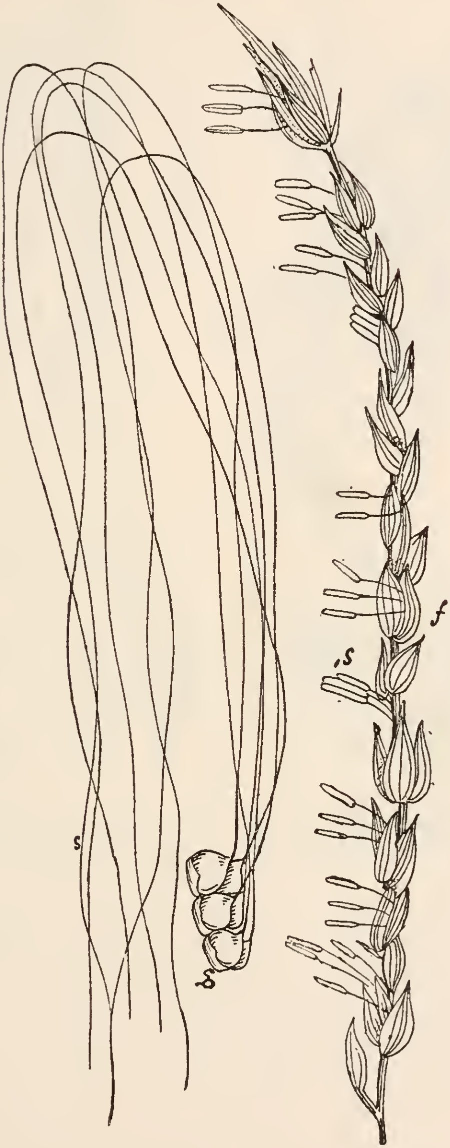


Fig. 137. Corn (*Zea mays*). To the left pistillate flowers; g, ovary; s, stigma; to the right staminate flowers; s, stamens.

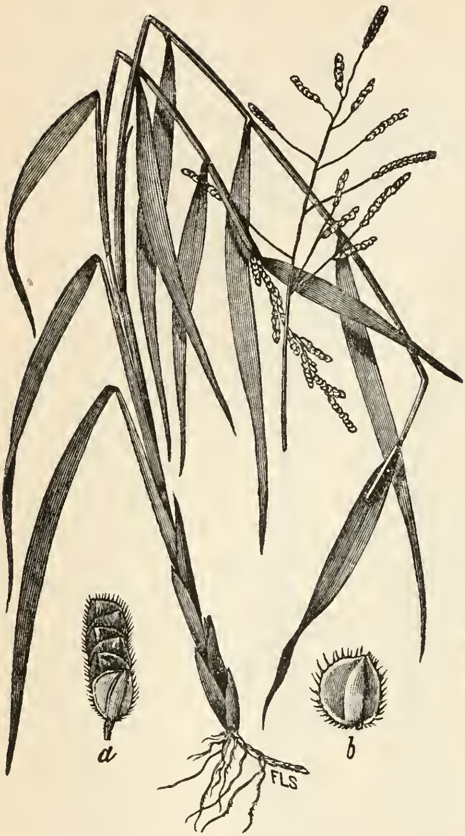


Fig. 137a. Rice-cut-grass (*Leersia lenticularis*). The sharp edges of the leaf of this grass often cut the flesh of animals.

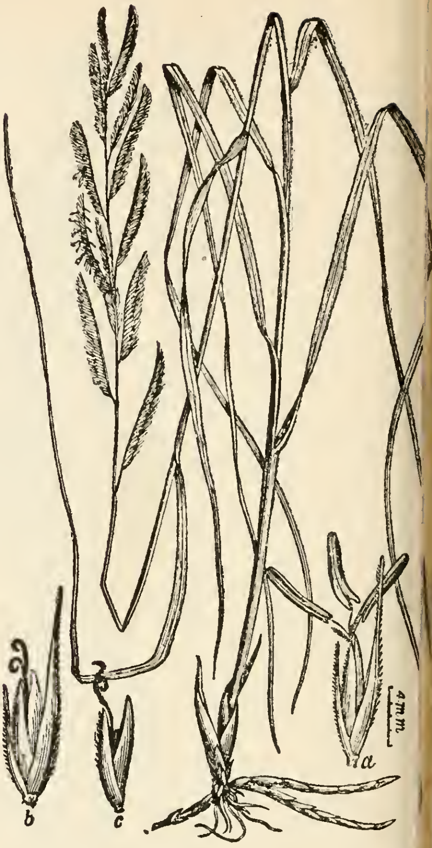
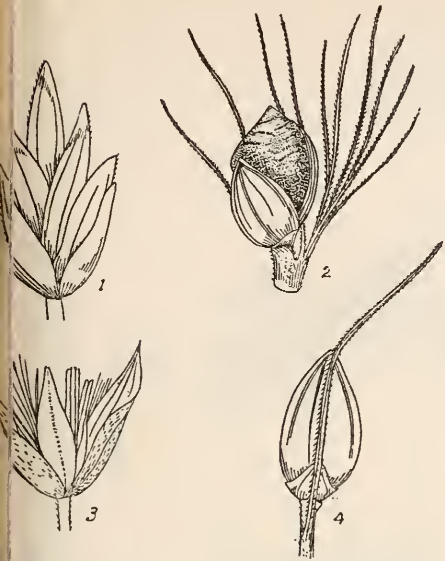


Fig. 137b. Porcupine grass (*Spartina cy*
oides). The sharp edges of this leaf cut like a
often wounding animals.

A large order of about 3500 species, many of which are very important to man. Among them are the wheat, oats, rye, corn, wild rice, sorghum, and sugar cane, the two latter being the sources of some of the sugar of commerce. Many grasses, also, are important forage plants, among which may be named blue grass, timothy, brome grass, and red top. Some grasses are used in medicine.

The Bamboo, native of the tropics, is valuable, being used not only for building purposes, but also in the manufacture of household furniture and in other ways.

Very few of the grasses have deleterious properties. A few, such as sleepy grass and millet, the latter of which is injurious to horses, are known to be poisonous. Some grasses, because of their stiff awns, penetrate the skin and even perforate the intestines, inflicting dangerous wounds. Needle grass and squirrel tail grass, or wild barley, are known to inflict injuries by lodging between the teeth, thus causing pus infection.



g. 137c. Spikelets of various grasses. 1. n blue grass (*Poa pratensis*). 2. *Setaria* 3. Spikelet of blue-stem grass. 4. Bristly (*Setaria verticillata*).

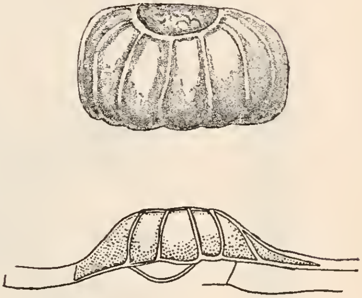


Fig. 137d. Scent glands of stink grass (*Eragrostis major*).

A great many grasses, because of their sharp edges on the leaf, inflict injuries by cutting the flesh. Of these we may mention the rice-cut-grass, (*Leersia*), and porcupine grass, (*Spartina cynosuroides*).

Holy grass (*Hierochloe odorata*) is sweet scented and contains coumarin. Indians use it to weave in baskets, mats, etc. Job's Tears, *Coix lachryma,* is used for rosaries.

KEY FOR GENERA OF GRAMINEAE

Spikelets jointed upon the rachilla below the glumes, 1-2 flowered.
Rachis bearded, spikelets spicate in pairs..................2. *Andropogon*
Rachis not bearded.
Pedicels bristle bearing......................................4. *Setaria*
Pedicels not bristle bearing.
Spikelets enclosed by a bur...........................5. *Cenchrus*
Spikelets plano-convex, not enclosed by a bur........3. *Paspalum*
Spikelets in pistillate flowers, borne on a cob............1. *Zea*
Spikelets not usually jointed above the persistent lower glumes.
Spikelets 1-flowered.
Awn simple twisted ....7. *Stipa*
Awn 3-pointed ....6. *Aristida*
Spikelets more than 1-flowered.
Spikelets 2-several flowered, rachis often bearded, flowering glume with a twisted awn.......................................8. *Avena*
Spikelets 1 or more-flowered with a zigzag jointed rachis, channeled.
Spikelets solitary at the notches.

Flowering glumes with the backs turned to the rachis...10. *Lolium*

Flowering glumes with their sides turned to the rachis...11. *Agropyron*

Spikelets 2-6 at each joint of the rachis.............12. *Hordeum*

Rachis not channeled....................................9. *Bromus*

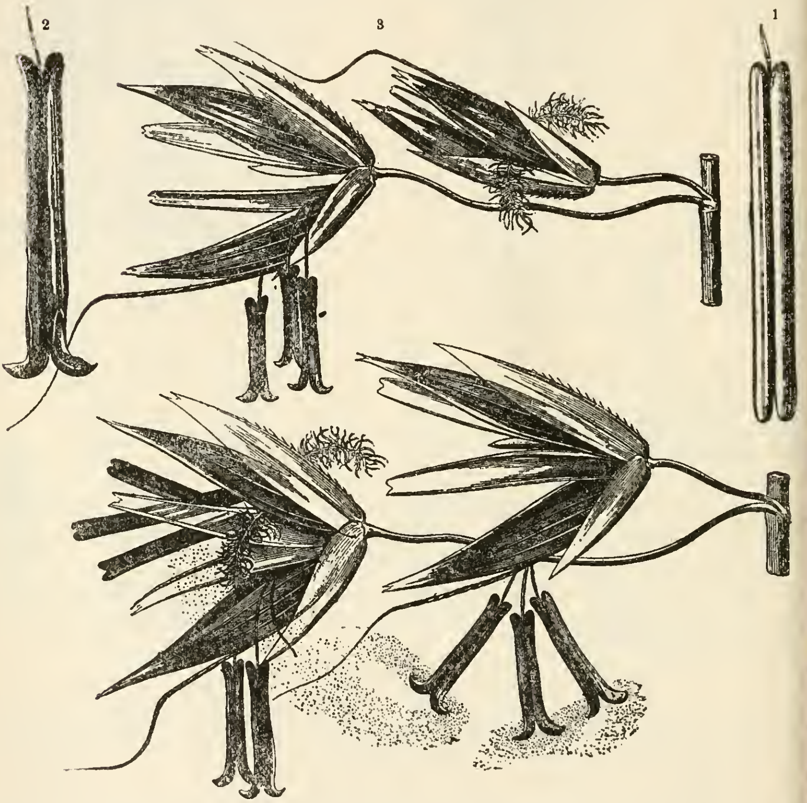


Fig. 138. Spikelets of tall-meadow-catgrass (*Arrhenatherum elatius*). 1 & 2. Stamens. 3. The lower flower with protruding styles; upper flower with protruding stamens. The lower scales are called sterile glumes. Each flower consists of a palet and flowering glume, stamens and pistil.

1. *Zea.* Mays. L.

Spikelets unisexual, monoecious; the staminate 2-flowered, in pairs, one sessile, the other pedicellate, arranged in terminal branches of a terminal panicle; the pistillate 1-flowered, sessile crowded in several rows, along the much thickened continuous axis arising from the lower leaf-axil and closely enveloped by numerous large foliaceous bracts; glumes 4, awnless; those of the staminate spikelet acute; those of the pistillate very broad and obtuse or emarginate; grain hard, only partially enclosed by the fruiting glumes. This well-known, tall, and striking annual grass has erect stems and broad leaves;

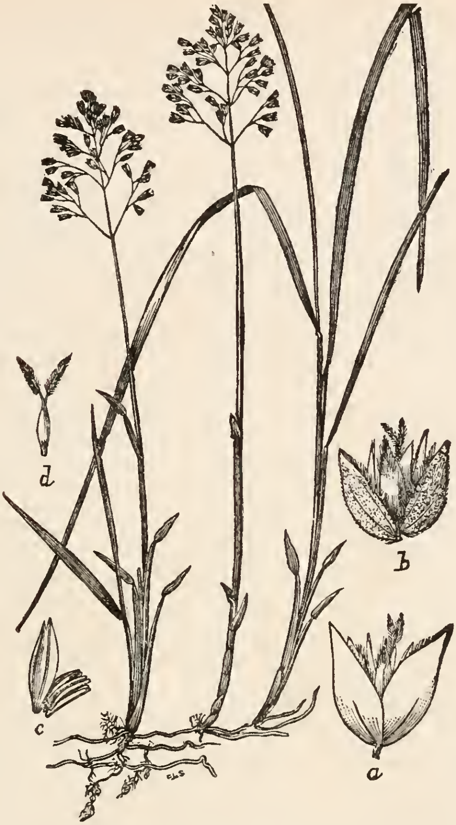


Fig. 139. Vanilla grass (*Hierochloe odorata*). a. Spikelet with nearly equal lower glumes; b, with lower glumes removed, showing third and fourth scabrous glumes; c, palea with stamens; d, pistil. (Div. of Agros. U. S. Dept. of Agric.).

the terminal, staminate inflorescence forms the "spindle" and the long, projecting styles of the pistillate flowers constitute the "silk"; the cob is formed by the union of the axes of several female spikes into a much thickened body.

The 1 or 2 species are of American origin, presenting many varieties in cultivation known as corn, Indian corn or maize (*Zea Mays*). Dr. Sturtevant has arranged cultivated corn into the following groups:

Pod-corn, *Zea tunicata.*
Pop-corn, *Zea everta.*
Flint-corn, *Zea indurata.*
Dent-corn, *Zea indentata.*
Soft corn, *Zea amylacea.*
Sweet corn, *Zea saccharata.*
Starchy sweet corn, *Zea amyleasaccharata.*

The so-called species and groups of Dr. Sturtevant are hardly to be regarded as varieties. Some of the forms under conditions of culture and climate, revert to the original type.

A plant cultivated for so long a time by the Indians and civilized man ha naturally given rise to diverse forms which we regard as nothing more tha races of the very polymorphic species *Zea Mays.*

Some years ago Dr. Watson obtained from Moro Leon, through Prof Duges, some corn which he considered a new species, calling it *Zea canina* He says:

> The natural supposition was that we had here at least the original wild state of ou cultivated maize. A careful comparison of the two, as thorough as the material at han of the cultivated forms would permit, has led me first to doubt the probability of this, an now to consider the form in question a distinct species. The differences upon which thi conclusion is based are in the habit of growth, the arrangement of the staminate spikelets, an the nervation of their glumes, the form of the glumes of the pisttillate flowers, and th ready disarticulation of the ripened ear.

Dr. Harshberger, who is certainly a most careful observer, and who carried on some most interesting experiments on hybrids, considers our maiz of hybrid origin and *Zea canina* is a hybrid of corn and Euchlaena. He says

> Maize relates itself botanically to a native Mexican grass, teosinte (*Euchlaena me icana*); and the fertile hybrids of this grass and maize are known, producing a pla described by Watson as *Zea canina.* From the peculiar behavior of these hybrids, th writer has suggested that our cultivated maize is of hybrid origin, probably startin as a sport of teosinte, which then crossed itself with the normal ancestor, producing o cultivated corn. This is speculative, but there cannot be any doubt that the close relatio ship of maize and teosinte points the way to the determination of the botanical characte of the original wild corn. Recently, Montgomery has suggested a theory as to th nature of the maize ear, in which, in conclusion, he states that corn and teosinte ma have had a common origin, and that in the process of evolution the cluster of pistilla spikes in teosinte were developed from the lateral branches of a tassel like structur while the corn ear developed from the central spike. It is probable that the progenito of these plants was a large, much-branched grass, each branch being terminated by a tasse like structure bearing hermaphrodite flowers.

Corn holds the first place in the list of crops produced in this countr and North America produces four times as much as the remainder of th world. According to C. P. Hartley, Europe stands second, South Americ third, and Africa fourth. As a corn-producing country the United States ha no rival; Argentina stands second, Hungary third, and Italy fourth. Th average corn yields in four central states for five years, 1902-1906, were follows:

State.	Bushels.
Illinois	342,115,835
Iowa	301,666,176
Nebraska	239,835,262
Missouri	210,082,426

Maize is one of the most important cereals of North America, being use as a food for man and stock, in the manufacture of starch and glucose, and medicine, the corn silk being used as a mild stimulant and diuretic. The c from the embryo is a yellow viscid transparent liquid having a peculiar od of corn meal. The silk contains maizenic acid.

Injurious properties. In many sections of the country where corn is grow and cattle allowed to feed on corn stalks, a disease occurs which has be called the corn stalk disease. This has been attributed to various causes su as corn smut, a bacterial disease, nitrate poisoning, bacterial poisoning, a impaction of the stomach. Corn stalks are not easily digested and it is not be wondered at that impaction should occur when cattle do not have access plenty of water.

This same disease goes under other names, and it may be that there are veral distinct types of diseases due to the feeding of corn stalks. Dr. Bit-ng describes a *Septicaemia hemorrhagica* which is caused by an organism, e cocco-bacillus. The symptoms of this disease are as follows:

> The symptoms depend upon the point of attack. If the respiratory system be attacked, ere will be a rapid rise of temperature, difficult and rapid breathing, standing with the et wide apart as in pneumonia, short coughing, the tongue protruded, and eyes prominent d congested. The animal will move only when urged to do so The attack lasts for ly a few hours. If the pneumonia be of less severe type the kidneys and bowels may ow some affection before death.
>
> If the bowels be the seat of attack, there will be bloating colic, noisy intestinal move-nt, straining and diarrhea. The bowel movements are soft, fluid, and foul smelling, d may be blood stained. The urine will also be blood stained. If the infection take ice from a superficial abrasion, the part will swell rapidly, become very large, be hot and inful, does not pit upon pressure, and does not crepitate. The swelling extends rapidly d if in the region of the neck, will cause suffocation. The course is short and generally al.

Dr. Bitting states that this disease must be differentiated from the corn alk disease due to poisoning and that post mortem must be the means of paration in some instances. The only remedy is a change of pasture, as little n be done otherwise.

Recently much interest has been attached to the disease known as Pellagra, ich has been treated elsewhere in this volume, but in this case it may be of erest to know that the disease has made its appearance in several of the uthern states, notably Alabama and South Carolina; cases have also been ported in Maryland and Massachusetts, and a number of them in the Insane spital in Illinois. It is believed by the experts who have investigated this estion that it is in some way associated with corn. For instance, Dr. vinder who investigated this disease with Assistant Surgeon-general Wyman, es the case of the disease on the Island of Corfu, where an epidemic followed en the people began to use an inferior imported quality of maize. Previous this they had used their own maize which was carefully selected and pre-red. There can be no question according to Lavinder that the introduction maize collected in Spain, France, and Italy, with unsanitary conditions and use of poor maize greatly influence the spread of this disease in those ntries. It is practically unknown in those countries where maize is not a ple article of food.

Dr. Arlsberg, of the U. S. Department of Agriculture, in a discussion of s disease before the American Society of Tropical Medicine, states that n is one-fifth of the food of the Tennessee and Georgia mountaineers and -third of the food of the negroes. Under the present conditions this corn collected before maturity and often is shipped to distant points in poorly ntilated cars which makes it possible for moulds of different types to develop. rthermore, the same person is authority for the statement that, in ten gen-tions the fat content of corn has increased from less than 5% to 7 1/3% d that toxins are found to be related in quantity to the oil produced in the d. Then, too, the weather conditions in this southern corn region have n extremely favorable in the last ten years for producing corn which would immature and subject to moulds when transported.

Now it is a well known fact that for many years throughout the south y have had trouble with the so-called forage poisoning affecting live stock ich had been fed corn, especially when mouldy. It seems to the writer that there is some relation existing between Pellagra in man and forage poisoning in horses and cattle. Both are essentially produced by some toxic substance.

In this connection, the bulletin on the Grand Traverse or Lake Shore Disease, as investigated by C. D. Smith,* C. E. Marshall and Dr. Ward Giltner, is interesting.

2. *Andropogon.* (Royen.) L. Beard Grass

Tall annual, or perennial grasses with spikelets in pairs upon each joint of the slender rachis; usually narrow leaves; terminal and axial racemes, one of them sterile, the other sessile, 1-flowered, and fertile; lower glume the larger, coriaceous and nerved, the second acute; stamens 1-3, grain free.

About 150 species widely distributed in tropical and temperate regions. Some of the species of the *Andropogon* L. are excellent grasses for forage purposes. Quite a number of them produce valuable oils like *Pamorusa* oii, obtained from *Andropogon Schoenanthus,* lemon grass oil from *Andropogon*

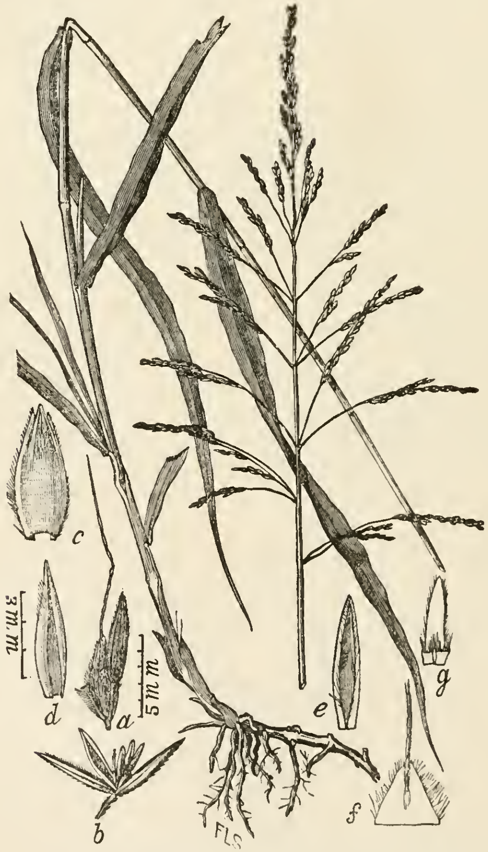


Fig. 140. Johnson-grass (*Andropogon halepensis*). a, spikelet; c and d, glumes; e, f, g, parts of the flower.

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* Sp. Bull, Mich. Agr. Exp. Sta. 50: 10.

citratus, and citronella oil from *A. Nardus*. The fibrous roots of the aromatic Cuscus grass of India (*A. muricatus*), produce a substance used mainly as sachet powder; the fibres of the plant are used extensively by the natives in making mats.

Andropogon halepensis. Brot. Johnson Grass

A stout perennial with smooth, erect, simple culms, 3-5 feet hight; and strong creeping rootstocks; panicle open, 6-12 inches long; the 3-5 flowered racemes clustered toward their extremities; outer glume coriaceous, second glume equaling the first and convex below, the third glume shorter than the outer ones, membranaceous, palet broadly oval; fourth glume ciliate awned; palet shorter than the glumes; nerves ciliate.

A troublesome weed throughout the Southern States. First introduced as a forage plant.

Andropogon Sorghum. Brot. Sorghum

An annual with long, broad, flat leaves and ample terminal panicle; spikelets in pairs at the nodes, larger and rounder than in the preceding; rachis not articulate; sessile spikelet with 4 scales, the outer hard and shining, the inner hyaline; the fourth scale on and subtending a small palet and perfect flower, or occasionally the palet wanting.

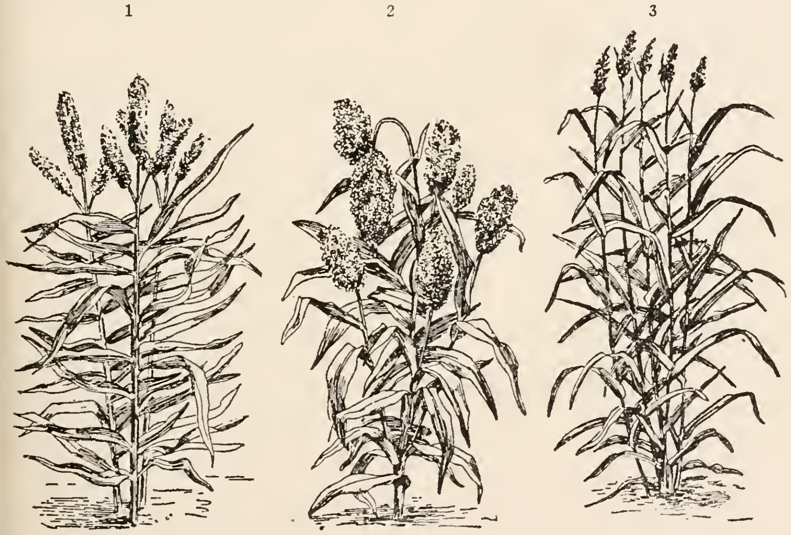


Fig. 141. Sorghum (*Andropogon Sorghum*). 1. Kaffir corn; 2, Jerusalem corn; 3, Amber sorghum. (Kansas State Board of Agrl.).

Sorghum is contained in a number of cultivated plants which are classified by Mr. C. R. Ball under (1) Broom Corn, (2) Shallu, (3) Durra, (4) Sorghum and (5) Kaffir. Broom Corn used for the manufacture of brooms, is grown chiefly in the central Mississippi Valley, Kansas, Oklahoma, and the Panhandle of Texas. The Shallu, also known as Egyptian wheat, is cultivated extensively in India. The Durras have been cultivated for centuries in Egypt, and other countries of Africa, and in India for human and animal food. They are now cultivated in the United States, chiefly from Kansas to Texas. The Kaffir, native to eastern Africa from Abyssinia to Natal, was introduced into this country in 1875, and is grown chiefly in the semi-arid regions for forage. Sorghum is grown largely for fodder. The pithy juice contains cane sugar in variable amounts, and is used both for sugar and in the making of syrup, although the growing of sorghum for syrup seems to be on the decline. According to the census of 1890 the production was 24,000,000 gallons; in 1900, 17,000,000.

Poisonous properties. Sorghum has long been recognized as poisonous. Mr. C. W. Warburton in Bailey's Encyclopedia of Agriculture, says:

> Sorghum makes excellent pasture for hogs, but in many sections it must be pastured sparingly, if at all, by sheep and cattle. After periods of extreme drought, or when growth is stunted from other causes, the leaves of the sorghums often contain a large amount of prussic acid. A small quantity of this poison is fatal to stock, and death frequently results soon after the sorghum is eaten. Normal growth seldom contains prussic acid in appreciable quantities, and it largely disappears in curing, so that cured sorghum may be fed with little danger. There is also some danger from bloating; cattle and sheep should not be turned on sorghum pasture when hungry or when the plants are wet. With the exercise of care, however, the crop can usually be pastured with safety. It should be at least two feet high before stock are turned on it; for cattle, sheep and horses it may be much more matured than for hogs.

Frosted cane is said to be especially injurious. Dr. R. H. True, of the U. S. Dept. of Agriculture, in commenting on the poisons from sorghum, says:

> This office has from time to time received communications from stockmen, especially in the lower part of California, Arizona, and adjacent territory, expressing a suspicion that the eating of the Johnson grass had caused the death of stock with rather sudden and violent symptoms. There has seemed to be little ground in poisonous-plant literature to support such an explanation. Last summer, however, convincing observations were reported from California by a stockman who had lost heavily, and a supply of the grass in question was obtained. The result of the study of this material was positive.

Mr. A. C. Crawford, who investigated some cases, says:

> It has been noted that deaths in cattle frequently occur when, on account of the failure of rain, the plants which have reached a certain size become stunted and withered. The toxic principle appears simultaneously over a wide area, but soon disappears if a rainfall occurs. The deaths of cattle have been attributed by some to an insect living upon the plant, and in Australia it is the belief that*Sorghum vulgare* which also yields hydrocyanic acid, becomes more poisonous when attacked by an insect during a drought. A similar observation has been made with *Sorghum vulgare* in the Sudan. Balfour found that one specimen of the plant which harbored aphids yielded more hydrocyanic acid than a second one without parasites. Pease has lately claimed that the deaths from Johnson grass in India were really cases of nitrate poisoning, as he found 25 per cent of nitrate of potassium in the stem of the plant and was able to produce somewhat similar symptoms in animals by feeding them this salt. Johnson grass is being introduced into Australia as a fodder plant, but as yet no reports of its poisonous action there have been noted by the writer.

Dr. George H. Glover of Colorado, also reports large loss of cattle in that state from eating Kaffir corn. Twenty-one head out of thirty-two cows died within an hour after first being placed upon the feed. Dr. A. T. Peters of Nebraska, investigated the subject of poisoning from sorghum and Kaffir corn. He states that in most cases where death of animals occurred, the animals did not regularly pasture upon sorghum, but broke into the fields from adjacent pastures or as they were being driven past fields of sorghum. The investigations proved that the animals did not die from bloat as had been reported. Dr. Peters speaks with authority as he examined the cases at first hand:

> In response to one of these calls, I reached the farm of Mr. Bert Foss, near Aurora, at 7:30 A. M., on August 3, 1901. Two days previous, fifteen head of his cattle had broken into a sorghum field, where they had remained twenty minutes. They were then driven into another field and were not seen again for several hours. When seen, three were sick, all of which died within a few hours. The symptoms were drowsiness, running at the eyes, twitching of the muscles, numbness of the limbs, staggering gait, inability to stand, involuntary passing of urine. On August 2d, two more cows broke through the fence and were on the sorghum field five minutes. One hour later, one of these animals, a four-year-old cow was very sick, but finally recovered.
>
> We turned a small yearling steer on the sorghum at 8:30 A M., August 3d, but he refused to eat any sorghum, and after thirty-five minutes, two more were turned into the sorghum, where they remained until 10:00 A. M., when only one, a small, red steer, had taken any sorghum, and he had eaten only a few leaves. They were then turned back with the herd. At 10:35 A. M. the small, red steer acted somewhat drowsy, but soon recovered.
>
> At 11:00 A. M. we turned one red heifer and one yearling steer on the sorghum. The heifer was the only animal that ate any quantity, and, as subsequent examination showed, she ate only one and one-half pounds of green sorghum. At 11:10 this animal dropped to the ground. Upon examination it was found that she had stopped chewing her cud and there was a peculiar twitching of the muscles of the nose and head and also of the body. The animal was very dull. At 11:15 A. M. she was taken out of the sorghum field and allowed to lie in a stubble field. When lying down her head was turned toward the abdomen, presenting the symptoms shown by a horse having the colic. The eyes seemed dull and gave off a water discharge. There was a partial paralysis of the tongue and great quantities of saliva ran from the mouth The limbs and ears were cold. The pupils of the eyes dilated, pulse not perceptible, mucous membrane of the rectum protruding, involuntary discharge of urine and faeces. Upon pricking the animal with a knife on the lower limbs it showed no feeling. The animal was closely watched in the field by Mr. Foss and myself and we observed that she did not take any weeds, but simply a small amount of sorghum, eating only the tops of the leaves. At 1:30 P. M. the animal was still lying on its right side; all the muscles of the head were contracted and showed involuntary twitching. The limbs were paralyzed and the animal was unconscious; the mucous membrane of the mouth was of a salmon color. At 2:35 P. M. the animal was in great pain, and it was apparent that she would not recover. At the suggestion of Mr. Foss the animal was killed in order to hold a post-mortem examination.

Post-Mortem Examination.—Animal still warm. The bowels were opened and contents of paunch carefully noted; there was in all one pound and a half of sorghum leaves to be found in the paunch. No sourness of the contents. The same was immediately put up in Mason fruit jars with clean water and brought to the laboratory. The mucous membrane of the intestines normal, all other conditions of the animal normal.

In regard to the Colorado disease, the following statement is made:

> The cattle died on August 20th last. We lost 21 head out of 32 head which had been turned on the corn. Eleven head lived, but 4 of the 11 head had violent spasms, but recovered. The other 7 head were not affected. They were only on the corn 5 or 6 minutes. The first cow died in 15 minutes; nearly all within an hour. One yearling lived over 6 hours I gave it several doses of aconite, thinkng possbly one poison would counteract the other, but it died in great agony. The cattle seemed to all go crazy at once, then stagger like a person intoxicated, fall in all directions, and die where they fell. I stuck all of them with a knife, the same as in alfalfa bloat, but there wasn't any gas in them. The Kaffir corn was planted on sod ground above irrigation. It was from 6 to 15 inches high and was burnt brown from the drouth."

Shortly after the poisoning, Dr. Glover visited the field and collected samples, which he generously placed at our disposal. These samples yielded prussic acid in greater amounts than any yet examined in Nebraska.

It appears more than probable that the sorghum plant under different climatic conditions and different conditions of growth may produce varying amounts of prussic acid. I was told in Texas that the sorghum most poisonous to live stock is the second growth.

In regard to the chemistry of the subject, Dr. S. Avery says:

> In 1886 Berthelot and Andre ascribed the cause to excessive amounts of potassium nitrate (salt peter). Williams of the U. S. Department of Agriculture also suggests saltpeter as a cause of the trouble. Hiltner has shown that the amount of nitrate in Nebraska fields was too small to produce fatal results. This writer suggests that the plant under certain conditions develops a highly poisonous chemical compound. Slade in the Annual Report of the Station for the present year (1902) put forward the theory that such a compound might be produced by the action of an enzyme upon a glucoside found in the plant through a process of abnormal growth. On June 27th of the present year the Chemical News of London contained an article on Cyanogenesis in Plants by Dunstan and Henry. This article, which finally confirms Slade's prediction, was not known to Mr. Slade or to the writer till October 10th. In brief, the English Chemists isolated from Egyptian *Sorghum vulgare* a glucoside capable of liberating prussic acid. In the meantime Mr. Slade had detected Prussic acid in fatal sorghum grown in western Nebraska, determined the per cent, and secured strong evidence in favor of the glucoside theory.
>
> During the first two weeks in September, the writer discovered that Prussic acid could be obtained from leaves of healthy sorghum in the fields about the Station. As the past season was abnormally wet, nearly all of the fields had made a vigorous growth. By distilling water from a sufficient quantity of leaves, determinable amounts of Prussic acid were evolved in all cases, though the amount was well below the danger line. Of the common Nebraska forage plants, sorghum and Kaffir corn alone yield Prussic acid.

The substance *dhurrin* $C_{14}H_{17}NO_7$ occurs according to Dunstan and Henry in young plants of *A. Sorghum.* A glucoside resembling that found in almonds also occurs; it differs however but is capable of being converted into hydro cyanic acid, HCN. The investigations made at this station show that the prussic acid is not present as such, but that it is liberated from a glucoside. (1) by an enzyme in the plant as in the case of sorghum poisoning, and (2) by the action of boiling water on the plant. Glucosides of this sort are in themselves harmless and are dangerous only when they liberate prussic acid. The experiments mentioned above also showed that even dried plants may contain a very large amount of combined prussic acid. We should expect that such a fodder would be as fatal to stock after curing as when standing in the field. Experience, however, seems to prove the contrary. Enzymes rapidly become inactive when dried in the presence of protein substances, according to Dr. A. F. Woods, Chief of Division of Plant Pathology.

Antidotes. Prussic acid has a tendency to unite with certain carbohydrates, forming additional products. These compounds are much less poisonous than the free acid. Both glucose and milk sugar unite with Prussic acid to some extent even in dilute solutions. Aside from this action these carbohydrates retard the action of the enzyme in liberating Prussic acid. These facts suggest that, in case the animal is not in such a conditon as to render medical treatment out of the question, the following may be affective:

A strong solution of glucose, which nearly every farmer has at hand in the form of "corn syrup" or molasses, may be administered.

Large quantities of milk have in a number of instances been administered apparently with good effect.

In all cases the animal should have as much fresh air as possible.

3. *Paspalum*, L. Paspalum

Spikelets spiked or sometimes racemed, in 2 to 4 rows on one side of the flattened or filiform rachis, awnless, 1-flowered; glumes 3, rarely only 2, 1 glume flowering; flower coriaceous, orbicular or ovate; stamens 3; spikes 1 or more at or toward the summit of an elongated peduncle.

Species about 160, chiefly in warm temperate regions in both hemispheres. In South America they constitute an important part of the plants of the Pampas. One species is used in medicine and several species are excellent forage plants for the South. One species is troublesome as a weed in the Southern States. The Koda Millet (*P. scrobiculatum*) known to be poisonous and injurious to animals and man in India is used during times of scarcity of food and causes poisoning. The seed, especially the testa and pericarp, contains a narcotic poison which causes delirium and vomiting. Cattle should not be allowed to feed on it when it is ripening.

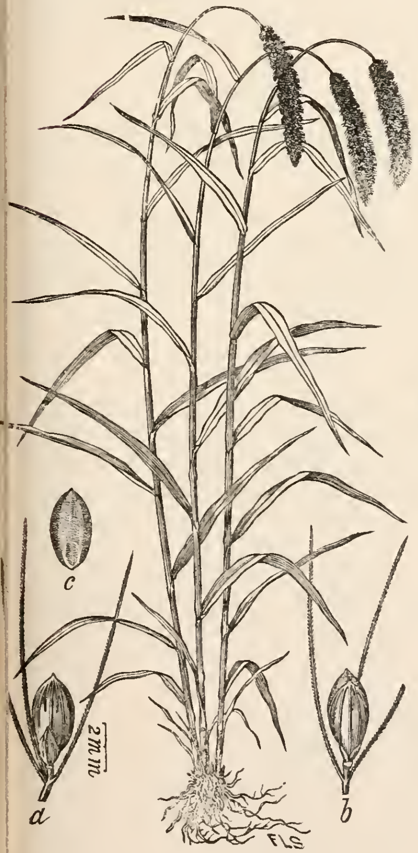


Fig. 142. Corean Foxtail (*Setaria italica.*)

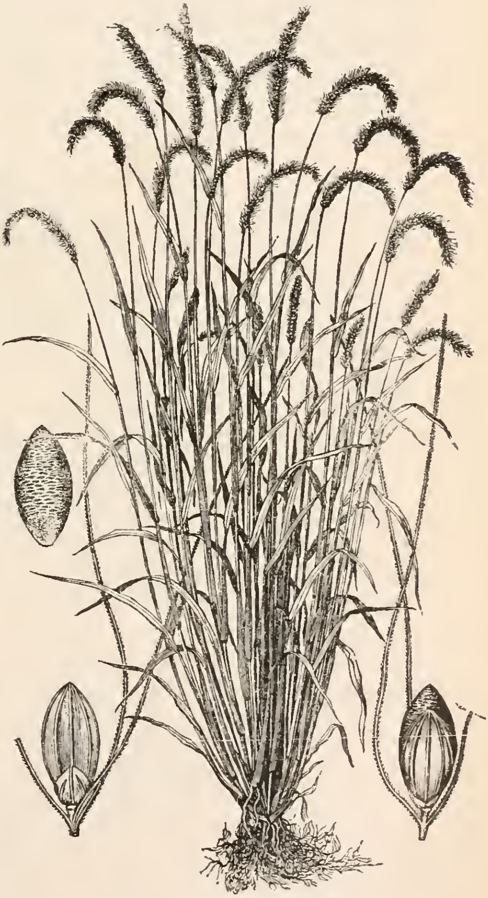


Fig. 143. Corean Foxtail Millet (*Setaria*). U. S. Dept. Agr.

4. *Setaria,* Beauv.

Spikelets jointed upon the pedicels, panicle densely racemed or spiked, surrounded at the base by a few or many persistent awn-like bristles, which rise below the articulation of the spikelet.

Species about 10, in temperate and tropical regions. Some species are used as food, especially in China, Japan and India. Several are important forage plants, like the broom corn millet, and Hungarian grass. Three species are weedy in eastern North America.

Setaria italica, Beauv Italian Millet or Hungarian Grass

A stout, erect, somewhat glaucous annual, 3-8 feet high, with broad leaves; large, dense, compound, spiciform panicles 3-8 inches in length; nodes bearded, with short, appressed hairs; leaf-blades lanceolate, narrowed at the base, long-acuminate, 8-16 inches long, ½ to 1¼ inches wide, scabrous; panicles dense, cylindrical, ½ to 1½ inches in diameter; rachis densely villous; setae 1-3, green or purplish, retrorsely scabrous; spikelets elliptical, strongly convex, 1½ to 2 lines long, obtuse; second and third glumes about equaling the flowering glume, 5-7-nerved; flowering glume glossy, nearly smooth. Widely cultivated. Quebec to Minnesota, south to Florida and Texas.

Setaria germanica, Beauv. German Millet

A caespitose annual, from 1-3 feet high, with narrow panicles, about ½ inch in diameter, and long, usually purple setae; some forms approaching *Setaria viridis.*

This form is usually regarded as only a variety of the Italian Millet, and is found in cultivation only or perhaps springing up from seed on land cultivated the preceding season. The German Millet differs from the Italian in having a more dense or compact, and usually erect panicle or "head." Widely cultivated in most parts of the world.

Poisonous Properties. Numerous complaints have been made from time to time with reference to poisoning from millet.

Dr. Hinebauch states in regard to this trouble that in the winter of 1891 and 1892 a disease commonly called millet disease was prevalent to a considerable extent in North Dakota and that this disease was attended by a death rate of 7-10 per cent. It received the name of millet disease from the fact that from 95 to 98 per cent of the animals that were affected had been fed on millet. He says:

"When millet is fed in considerable quantities it stimulates the kidney to increased action. The urine is light colored and the bladder evacuated every two or three hours, large quantities of water being passed at each time. At the time the first symptoms of lameness were noticed, the kidneys had almost ceased to act."

And then he goes on to say:

"When the cause was kept up a sufficient length of time for the reaction to set in, the material which would under normal conditions be secreted by the kidneys was allowed to remain in the system and produce deleterious effects."

Apparently the condition of the millet had little to do with this action. In a later bulletin on the same subject Dr. Hinebauch reports a more extended investigation, giving considerable experimental data as well as urinary analyses.

The post mortem examinations revealed some interesting facts. The cartilages on the ends of the long bones show deep furrows running in a direction parallel with the motion during flexion and extension.

Both grooves of the astragalus were partially denuded of cartilage, so that the corresponding elevations of the tibia which articulate in the grooves did not have cartilage interposed between them. The whole general appearance, instead of being of a white, glistening color, was of a dark, dull color bordering on brown. The fluid which escaped from the joint when opened, instead of being a yellow, amber color, was brown and contained red blood corpuscles, indicating that inflammation was present. The joint fluid was brownish black in color and contained red blood corpuscles.

In conclusion we would say that our experiments here have thoroughly demonstrated that millet, when used entirely as a coarse food, is injurious to horses. (1) In producing an increased action of the kidneys. (2) In causing lameness and swelling of the joints. (3) In producing infusion of the blood into the joints. (4) In destroying the texture of the bone, rendering it softer and less tenacious, so that contraction causes the ligaments and muscles to be torn loose. The experience of many farmers with whom I have talked confirms the above conclusion, and we could multiply case after case showing that the above conditions are the results of feeding millet.

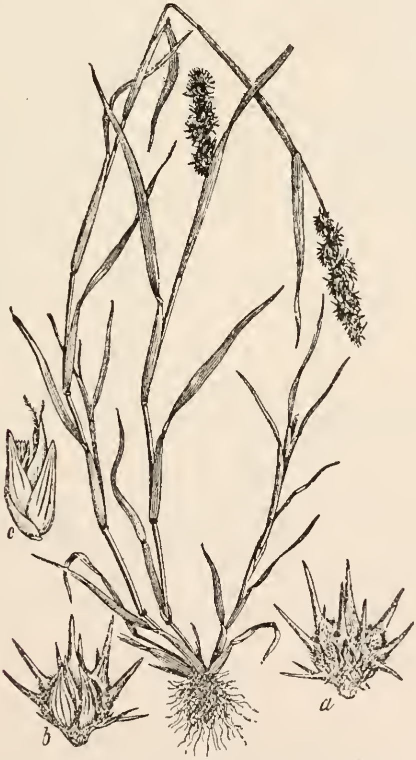


Fig. 143. Sandbur (*Cenchrus tribuloides*). , spiny bur enclosing spikelets; b, section of the same; c, lateral view of a spikelet. U. S. Dept. Agrl.

The North Dakota Station has published the results of further experiments on the subject of feeding millet. Two tests were made. In the first trial two geldings in good health were fed hay and grain for about two weeks. Millet was then substituted for hay for about ten days. These experiments confirmed those made previously.

Ladd has isolated a glucoside from the aqueous extract of millet hay, which, when fed in small quantities, gave the characteristic symptoms.

From the experiments made by Dr. Hinebauch and others, it would appear that feeding millets alone as coarse fodder is injurious to horses. It produces an increased action of the kidneys and causes lameness and swelling of the joints. It causes an infusion of blood into the joints and destroys the texture of the bone, rendering it soft and less tenacious, so that the ligaments and muscles are easily torn loose.

5. *Cenchrus*, L. Sand Bur

Annual or perennial grasses; flat leaves; spikelets surrounded by a spiny involucre which becomes coriaceous and forms a deciduous, hard, rigid bur which falls away at maturity; glumes 4, the 2nd and 3rd membranaceous, the 4th hard; the palea enclosing the perfect flower; stamens 3; styles united below.

Species about 12 in tropical and warmer temperate regions. One widely distributed from Maine to New York, Florida, Texas, California and the Dakotas.

Cenchrus tribuloides, L. Sand Bur

An annual with erect culms a foot or more high; flat leaves about 6 inches long; burrs of the involucre with strong, barbed spines; 2-flowered.

Distribution. Common in sandy fields and waste places; a weed along railroads and in sandy soil.

Injurious Properties. This plant frequently inflicts mechanical injuries. entering the flesh and thus causing serious inflammation. This applies to man as well as to lower animals.

Aristida, L. Triple Awned Grass

Perennial or annual grasses; narrow, often involute leaves; spikelets narrow, 1-flowered; outer glumes unequal, often bristle pointed; flowering glume tipped with 3 awns; palet small, 2-nerved; stamens 3; styles distinct; grain free, linear, enclosed in the scale; callus variable, often sharp-pointed and rigid. About 100 species in warmer regions of both hemispheres but of very little economic value, the majority being found in dry sterile soil; several species, like the Purple Aristida, however, are common in dry soils of the West. The latter is of little value for forage purposes. The awns of *Aristida hygrometrica* of Queensland bore into the skin of animals and occasionally reach the intestines, thus causing death.

None of our species produces serious trouble except, possibly, the Long-awned Poverty Grass.

Aristida tuberculosa, Nutt. Long Awned Poverty Grass

A rigid, much-branched annual, 12-18 inches high, with nearly simple panicles, 4-7 inches long; branches erect, rather distant, the lower in pairs, one short and few-flowered, the other elongated and many-flowered; empty glumes

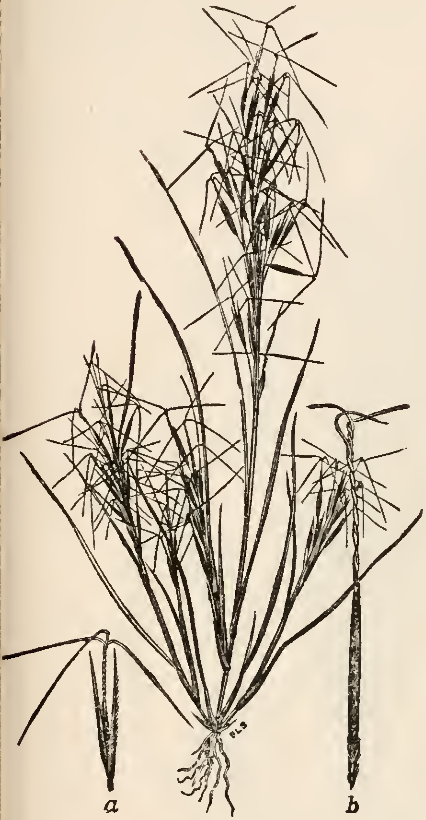


Fig. 144a. Long-awned Poverty Grass (istida *tuberculosa*). a, Spikelet with lower gme; b, flowering glume with divergent long ais. (U. S. Dept. Agrl.).

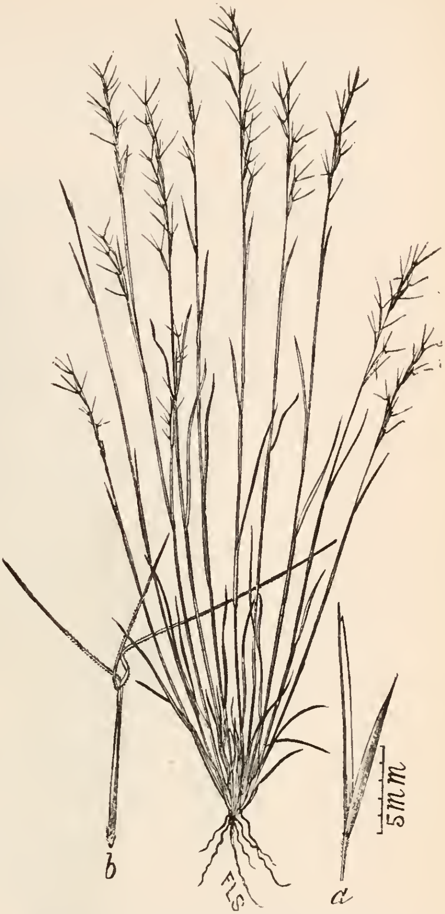


Fig. 144b. Short-awned Poverty Grass. (*A. basiramea*). Occurs in sandy and gravelly soils. (U. S. Dept. Agrl.).

nearly equal, 12 lines long, awn-pointed; flowering glume about 10 lines long, twisted above to the division of the awns, and with a densely barbate sharp-pointed callus; awns nearly equal, divergent or reflexed, 1½-2 inches long, distinctly articulated with the glume.

Injurious properties...The sharp pointed callus slightly injurious in the same manner as Stipa.

7. *Stipa*, L.

Perennial grasses with 1-flowered spikelets, flower falling away at maturity from the membranous, persistent, lower glumes, fertile glumes coriaceous, cylindrical, involute, and embracing the smaller palet and cylindrical grain; a long twisted or spiral awn jointed with the apex, the base consisting of a beard and sharp pointed callus; stamens generally 3; stigmas plumose.

About 100 species found in temperate and tropical regions. The Stipas often produce injurious effects upon animals.

Injurious properties. It has long been known that *Stipa capillata*, L., indigenous to Russia, and the *Stipa spartea*, Trin., and *S. avenacea*, L., native to North America, as well as *Aristida hygrometrica* Br., native of Queensland, and *Heteropogon contortus*, L., native of New Caledonia, frequently bore into the skin and intestines of lower animals where they cause fatal inflammation and peritonitis. Prof. Blanchard in a recent number in "Archives de Parasitologie" calls attention to injurious properties of *Stipa Neesiana* which is found in Uruguay and other countries of South America. In this case the needles injure the eyes producing in intense keratitis often followed by inflammation of the cornea. Sheep become blind and thus are unable to get food, hence

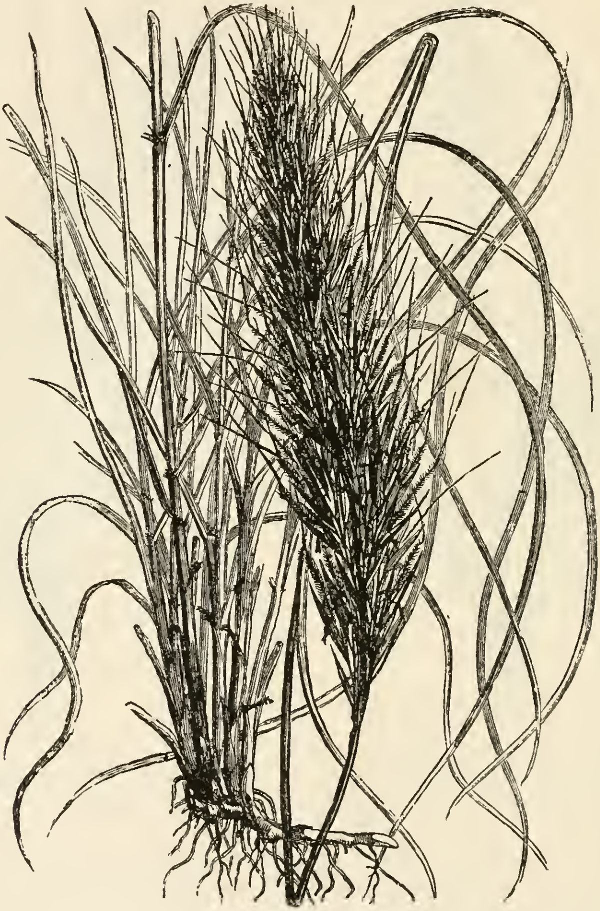


Fig. 145. Esparto Grass (*Stipa tenacissima*). Used for making paper, ropes and mats. It is not known whether this species, like the *St. inebrians* and the *S. sibrica*, acts like a narcotic on animals. (Baillon Dict.).

die from hunger and thirst. An instance is also recorded of a case where so many of these needles had accumulated among the feathers of an American Ostrich as to cause extensive ulceration which finally resulted in the death of the bird. The old world *S. inebrians* acts very much like our sleepy grass.

Stipa comata, Trin. and Rupr. Western Stipa. Needle Grass

A rather stout, erect, caespitose perennial, 1½-4 feet high, with mostly involute leaves; loosely-flowered panicles, 8 to 12 inches long; spikelets with nearly equal, long-attenuate-pointed, empty glumes about 12 lines long, and thinly pubescent flowering glumes about 6 lines long; awn slender, 2½-3 inches long, strongly flexuose or variously curled and twisted. Distributed in western Iowa, Nebraska, Utah, Oregon, California and Arizona.

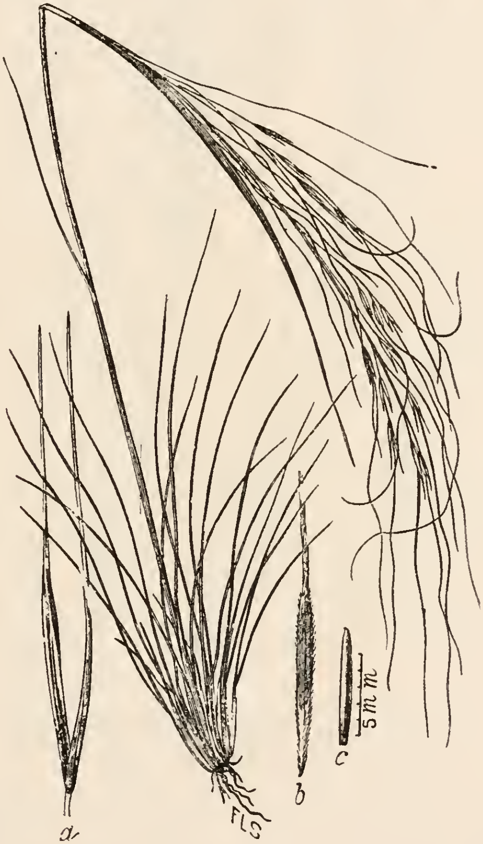


Fig. 146. Western Stipa or Needle Grass (*Stipa comata*).

Stipa spartea. Trin. Porcupine Grass

A stout, erect perennial, with simple culms 3 to 5 feet high; long, narrow leaves and contracted, few-flowered panicles, 4 to 8 inches long; spikelets larger; empty glumes subulate-pointed, 12 to 18 lines long, slightly unequal; flowering glume 8 to 10 lines long, including the barbed and very sharp-pointed stipe or callus, sparsely pubescent below and crowned with a few short hairs; palea nearly as long as the glume; awn stout, 3 to 6 inches long, twisted below and twice geniculate above. June to August. Common on dry, gravelly roads and high prairies.

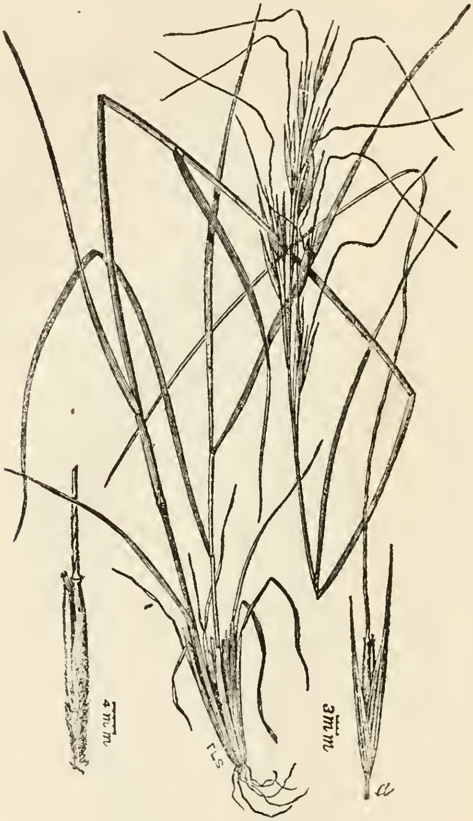


Fig. 147. Needle or Porcupine grass (*Stipa spartea*). a, a single spikelet; b, floret more highly magnified, with sharp pointed bearded callus. (Div. Agros. U. S. Dept. Agrl.).

Distribution. North America. From Wisconsin, Illinois to Missouri, Kansas, Nebraska, Dakotas and Minnesota to New Mexico, Manitoba to British Columbia.

Injurious properties. Dr. M. Stalker says the fruits of the porcupine grass are a frequent source of inconvenience and injury to living animals.

> In many of the northwestern counties of Iowa this grass grows in the greatest profusion, and during the latter part of June, the season for maturing and consequent falling of these spines, they are the occasion of much annoyance and in some instances the death of domestic animals. Only such animals as are covered with wool or a

thick growth of long hair are seriously inconvenienced. Sheep suffer most. The spines readily find a lodgment in the wool, and after burrowing through it frequently penetrate the skin and bury themselves in the flesh. A large number of these barbs thus entering the tissues of the body produce an amount of irritation that is sometimes followed by death. I have seen large numbers of these imbedded in the skin and muscular tissues of shepherd dogs that were covered with a thick growth of soft hair. These sagacious animals frequently exhibit the greatest dread at being sent into the grass during the season of danger.

Professor Bessey in his inquiries into the structure and nature of this plant received several responses, one of which, from Professor King, formerly of the University of Wisconsin, was as follows:

> In connection with the two notes relating to the fruit of the porcupine grass, it may not be without interest to say that while engaged in geological work in Dakota, north of the Northern Pacific railroad, we were much annoyed by the fruit of this grass. Indeed, I found the only way to walk with comfort through this grass was to roll my pants above my knees and my socks down over my shoes. I also observed, on several occasions, these seeds planted two inches deep in the soil with the awns protruding from the ground. It is plain that with the point of one of these fruits once entered below the soil, the swelling and shrinking, due to varying amounts of moisture, would work the seeds directly into the ground.

The *Stipa comata*, or needle grass of the west, which is common throughout the Dakotas, and throughout west Dakota, Nebraska, Wyoming and Colorado, is common in prairie hay, and Prof. Thomas A. Williams mentions that, though a forage plant, and not cut until the needles have fallen so that the stock may not be injured, the fruit of this plant often injures stock to a considerable extent. During the past summer in Alberta, Canada, the writer suffered some inconvenience from the penetration of the fruit through the clothes.

Stipa robusta, Vasey. Sleepy Grass

A large grass from 4-6 feet high growing in dense clumps; leaves involute, setaceous, large, flattened, 1-2 feet long; panicle 1-1½ ft. long; spikelets 4-5 lines long, on short pedicels; empty glume nearly equal 3-5 lines long; variable in length up to 1½ inches, slender flexuous; palet about ½ length of glume.

Distribution. From Colorado to Texas and Mexico.

Poisonous properties. This is the grass which is properly called Sleepy Grass and is poisonous. Dr. Vasey says the variety in parts of Texas and Mexico is known as Sleepy Grass, so called for its intoxicating and narcotic effect upon horses or cattle which feed upon it.

In the west this species of grass has received the common appellation of sleepy grass. It has long been regarded by range people as poisonous. Dr. Palmer, who found this grass in Coahuila, observed that it was poisonous to cattle, horses, and sheep, causing them temporary sleepiness. Later Dr. Havard states that in 1888 he reecived from Dr. M. E. Taylor, of Stanton, N. M., a grass with the following statement:

> Hereabouts grows a grass — the eating of which by horses will, within a few hours, produce profound sleepiness or stupor, lasting twenty-four or forty-eight hours, when the animals rally and give no evidence of bad effects. It is known among cowboys as "sleepy grass" and dreaded by them on their "round ups" as their horses are liable to eat it and cannot then be kept up with the herds. The tradition is that horses that have once eaten of it will not touch it again.

To quote from Dr. Havard:

> From the same gentleman I received a letter in 1890, in which he says: "Since I corresponded with Dr. Taylor it has been brought to my notice that cattle are affected in a similar way to horses, and that the curious properties which so affect animals are contained in the blades. Quite a number of our horses have been ill this spring

after having eaten it. It usually takes them about a week to recover, during which time they are unfit for work, and especially so during the first three days."

Captain Kingsbury, of the Sixth United States cavalry, under date of March, 1890, wrote me from Fort Stanton that the sleepy grass affected nearly all his horses at two camping places. it was hard work to make them walk.

The similarity of symptoms, whether observed in Coahuila or in New Mexico, is certainly remarkable, and furnishes strong evidence of the substantial accuracy of the observations as reported. It would seem, then, reasonably established that this plant possesses narcotic or sedative properties, affecting principally horses, but also cattle and probably other animals; that animals are not fond of it but eat it inadvertently or when under stress of hunger; that cases of poisoning occur especially in the spring, when the radicle and lower blades first come up, and that the active principle resides in these blades, and perhaps only during that season.

8. *Avena*, L.,Oats

Annual or perennial grasses, usually with flat leaves and panicled spikelets; spikelets 2, many-flowered, or rarely 1-flowered; lower flowers perfect, the upper staminate or imperfect; empty glume unequal, membranaceous and per-

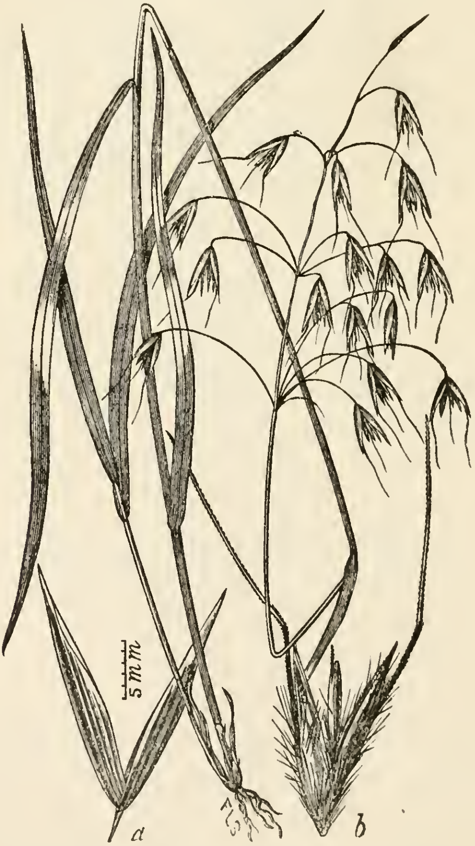


Fig. 148. Wild Oats (*Avena fatua*). a, empty glumes; b, flowering glumes. (U. S. Dept. Agrl.).

sistent; flowering glume deciduous, generally bearing a twisted awn on the back between the two acute teeth at the apex; rachis and base of flower often bearded; stamens 3, style short and distinct; grain oblong, linear, grooved on one side invested by the palet. About 50 species in temperate regions. The cultivated Oats (*Avena sativa*) is the best known representative of the genus and has long been used for food for man and animals. Several native species produce good forage.

Avena fatua L. Wild Oats

An erect, glabrous annual, 3-5 feet high, with flat leaves and spreading panicles of large, nodding spikelets; spikelets 2 to 4-flowered, with empty glumes ¾-1 inch long and pubescent; flowering glumes 6 to 9 lines long; awns nearly twice as long as the spikelets. Wild oats is highly esteemed as a forage plant on the Pacific Coast, especially California.

Distribution: Native to Europe but now abundant in grain fields of the Rocky Mountains, the Dakotas, Minnesota, and the Pacific Coast.

Injurious properties. Bezoars are sometimes produced by the common oat and Dr. Harz thinks it is a dangerous food material because it favors the development of these "hair balls." The barbed and awned seed of the wild oat may probably sometimes also lodge in the mouth and produce inflammation or other results of mechanical injuries.

Avena sativa, L. Common Oats

A well known erect annual, 2-4 feet high, with flat leaves and expanded panicles of rather large, pendulous, and, usually, 2-flowered spikelets. Lower florets sometimes awned.

Distribution. Widely cultivated in Europe, North America, Asia, and in all temperate regions. Commonly cultivated in Northern United States, Canada, and the Pacific Coast. The species is native to eastern temperate Europe. and western Asia, although the wild form has not been found. According to some authors, cultivated oats originated from wild oats *Avena fatua*. This s very doubtful.

Injurious properties. Harz reports the occurrence of phytobezoars in horses which had been fed oats straw. These bezoars in their origin and structure are similar to those occurring from feeding on cacti and the crimson clover referred to elsewhere.

9. *Bromus*, L.

Spikelets 5 to many-flowered, panicled; glumes unequal, membranaceous; ower glume 1-5 nerved; flowering glume either convex on the back or compressed-keeled, 5-9-nerved, awned or bristle-pointed from below to the groove of the oblong or linear grain; stamens 3; styles attached below at the apex of he ovary. Coarse grass with large spikelets at length drooping on pedicels hickened at the apex. About 40 species, of which Beal lists 27 as either native or introduced into the U. S.

Bromus tectorum, L. Awned Brome Grass

A slender, erect, leafy annual, 7-25 inches high, with narrow, softly ubescent leaves and open, nodding panicles, 3-7 inches long; spikelets each 5-8 owered, with unequal, acuminate-pointed, hairy, empty glumes, and rough or

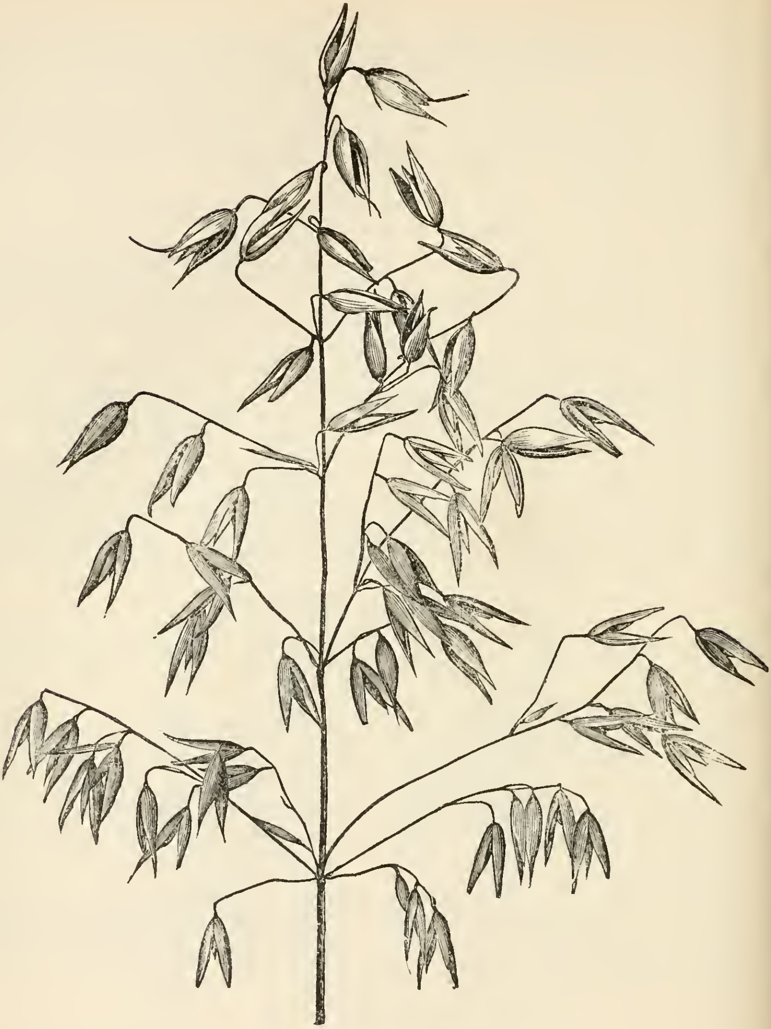


Fig. 149. Common Oats (*Avena sativa*), sometimes the cause of phytobezoars in animals. (Ia. Seed Co.)

hairy glumes 4-6 lines long; awns 6-8 lines long; blooming period from June to August. First introduced into the United States from Europe, it is without forage value, and, while not greatly troublesome in Iowa or eastward, has become a serious pest farther west, in Utah and Colorado.

Poisonous properties. This plant produces injuries similar to those caused by Squirrel-tail grass, the awned glumes working in under the teeth causing inflammation and suppuration. Animals eating this grass may lose their teeth as a consequence.

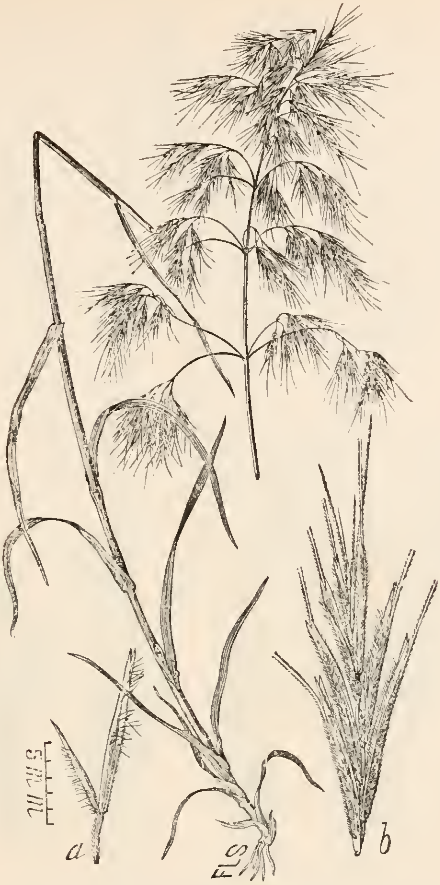


Fig. 150. Awned Bromegrass (*Bromus tectorum*). a. Sterile or outer glumes. b. Spikelet. U. S. Dept. Agr.

10. *Lolium*, L. Darnel and Rye Grasses

Annual or perennial grasses with flat leaves and terminal spike; spikelets many-flowered, solitary on each joint of the continuous rachis placed edgewise; empty glumes except in the terminal spikelets; only one flowering glume, rounded on the back, 5-7 nerved, palet 2-keeled; stamens 3; grain adherent to the palet, 6 species, 2 more or less naturalized in the eastern states. Natives of the Old World. Two species, the Italian rye grass and the common rye grass, are valuable forage plants. Darnel is a troublesome, poisonous grass.

Lolium temulentum, L. Darnel, Poison Darnel

An annual with smooth stout culm, 2-3 feet high; leaves with scabrous sheaths and short ligule; spike 6-12 inches long; spikelets 5-7 flowered; empty glumes sharp pointed, as long as the spikelets; flowering glume awned or awnless. Commonly found in grain fields.

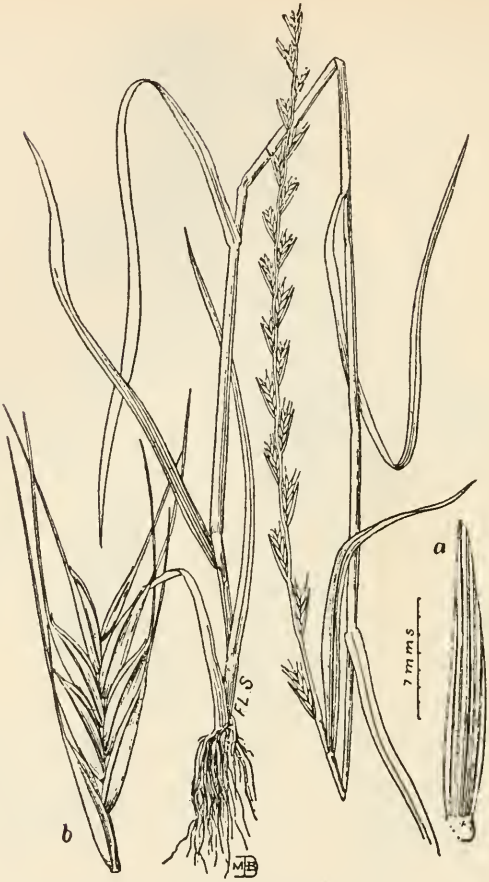


Fig. 151. Darnel (*Lolium temulentum*). b. Spikelet. a. Empty glume. U. S. Dept. Agr.

Distribution. Naturalized in eastern North America and abundantly so on the Pacific Coast.

Poisonous properties. It is a well known fact that a number of grasses are poisonous. It was well recognized by the ancients that darnel (*Lolium temulentum*) was poisonous, for it is written: "But while men slept, his enemies came and sowed tares among the wheat."

Darnel, when ground up with wheat and made into flour, is said to produce poisonous effects on the system, such as headache and drowsiness. This poisonous property is said to reside in a narcotic principle, *loliin*, a dirty white, amorphous, bitter substance yielding sugar and volatile acids, which, according to Hackel, "causes eruptions, trembling and confusion of sight in man and flesh-eating animals, and very strongly in rabbits, but it does not effect swine, horned cattle or ducks." Lindley states that the grain is of evil repute for intoxication in man, beast and birds, and brings on fatal convulsions. Haller speaks of it as communicating these intoxicating properties to beer. It acts as a narcotic, acrid poison. Darnel meal was formerly recommended as a sedative poultice. In Taylor's work on poisons, the statement is made that the seeds, whether in powder or in decoctions, have a local action on the alimentary canal and a remote action on the brain and nervous system. He states further that no instance is reported of its causing fatal injuries to man, and as much as three ounces of a paste of the seeds have been given to a dog without causing death. Then he goes on to cite the experience of Dr. Kingsley, in which several families, including about thirty persons, suffered severely from the effects of bread containing the flour of darnel seed. These persons had staggered about as if intoxicated. It is claimed by some investigators, however, that this plant is not poisonous. One writer claims to have made bread from flour said o contain considerable darnel and experienced no injurious effects. When nixed with flour and water the dough is foamy and narcotic in its action. There are other grasses which produce similar narcotic effects. Quite recently t has been claimed by several European investigators that the fruit of *Lolium emulentum* contains a poisonous fungus. Guerin states that the hyphae of a ungus constantly occur in the nucleus of the seed and the layer of the caryopis lying between the aleurone layer and the hyaline portion of the grain or ucellus. He also thinks that the toxic action of the Loliums is due to this articular fungus hypha. The threads were also found in *L. arvense* and *L. inicolum*; but, as yet, have not been found in *L. italicum* and but once in *L.*

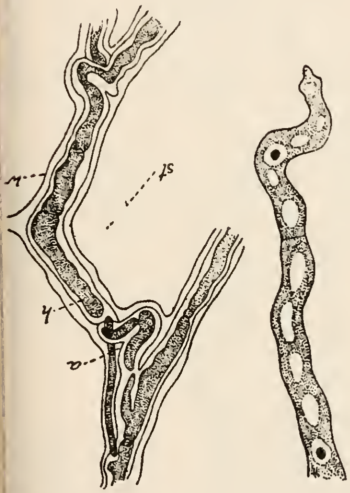


Fig. 152. At left, a hypha from eaf base of seedling of "Darnel" (*Lolium temulentum*). At right, hyphae in the starch endosperm of a seed. *h.* hyphal layer of grain nucellus, *st*, starch cell, *w*, wall of starch cell, *a*, knot formation in an intercellular space. After Freeman, redrawn by Charlotte M. King.

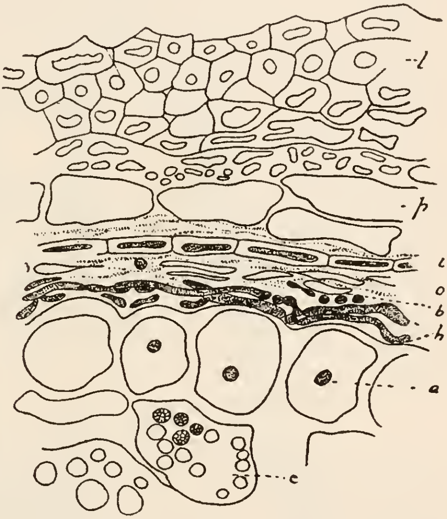


Fig. 153. "Darnel" (*Lolium temulentum*). Section of outer part of a grain which has been in a germinating chamber 24 hrs. *l*, pale, *p*, pericarp, *i*, crushed integuments, *o*, outer row of nucellus cells, *b*, cavities with nucellus (probably old cell lumina), *h*, hyphae, *a*, aleurone, *c*, starch endosperm. After Freeman, redrawn by Charlotte M. King.

perenne; the fungus is allied to *Endoconidium temulentum*, which has been found on rye.

The Lolium fungus, according to Guerin, lives symbiotically in the maturing grain and is therefore not a parasite, but Freeman has observed that occasionally it is injurious although it is generally stimulating. Nestler, who made an examination of *L. perenne, L. multiflorum, L. remotum*, and *L. festucaceum*, found nothing comparable to the fungus mycelium which occurred in *L. temulentum*. He also succeeded in demonstrating the presence of the mycelium of the fungus as indicated by Guerin. According to Nestler, the *Fusarium roseum* is identical with the fungus occurring in L. *temulentum* found by Guerin, but this has not been confirmed and seems very improbable. Hanausek considered the fungus to be related to the smuts, but Freeman found no evidence of spore formation; the septa are infrequent and the intercellular course different from that for smuts. The subject has, in recent years, been investigated by Prof. Freeman who, in a general way, confirms the reports of previous investigations and says:

> The probabilities of relationship with the ergot of *L. temulentum* are very interesting. The frequency of occurrence of ergots of *Lolium* in England is strangely coincident with that of the fungus in the grain, e. g., most abundant in L. *temulentum*, less so in *L. perenne* and exceedingly rare in *L. italicum*.

It is certainly not one of the rusts and the Ustilagineae are the closest affinity, perhaps, the fungus is carried from one generation to another by the sterile mycelium; when the embryo of the grain pushes out during germination, the hyphae, being in the "seed" keep pace with its growth and can be detected in the growing point throughout the life of the plant. Prof. Freeman says:

> The hyphae sometimes penetrate the aleurone layer at any point and invade the starch endosperm. There exists in the nucellus, at the base of the scutellum and at the lower end of the inner groove of the grain, a layer of hyphae which lies directly against the embryo, constituting an infective layer.

11. *Agropyron*, Gaertn. Quack or Wheat Grass

Annual or perennial grasses, with flat, or involute leaves; spikelets 3-many-flowered, compressed, 2-ranked, alternate on opposite sides of the solitary, terminal spike, 1 at each joint, or, occasionally, all, or the lower in pairs, sessile, with the side against the axis; glumes transverse, nearly equal and opposite, lanceolate; flowering glumes rigid, rounded at the back, 5-7 nerved, pointed or awned from the tip; palet flattened, bristly, ciliate on the nerves, adherent to the grain.

About 40 species, in temperate regions. The root of quack grass is used in medicine; several species, like western wheat grass (*Agropyron occidentale*) and slender wheat grass (*A. tenerum*) are valuable for forage purposes. Quack and western wheat grasses are also good soil binders.

Agropyron repens, (L) Beauv. Quack Grass

Perennial, 1-3 ft. high, from a creeping, jointed rootstock; sheaths usually smooth, scabrous, or pubescent above; spikes 3-10 inches long, erect; spikelets 4-8 flowered; empty glumes strongly 5-7 nerved near the apex, awnless or sometimes short awned.

Distribution. Widely naturalized, a good forage plant and also a bad weed. In eastern North America, it occurs in cultivated fields and by roadsides and is a troublesome weed.

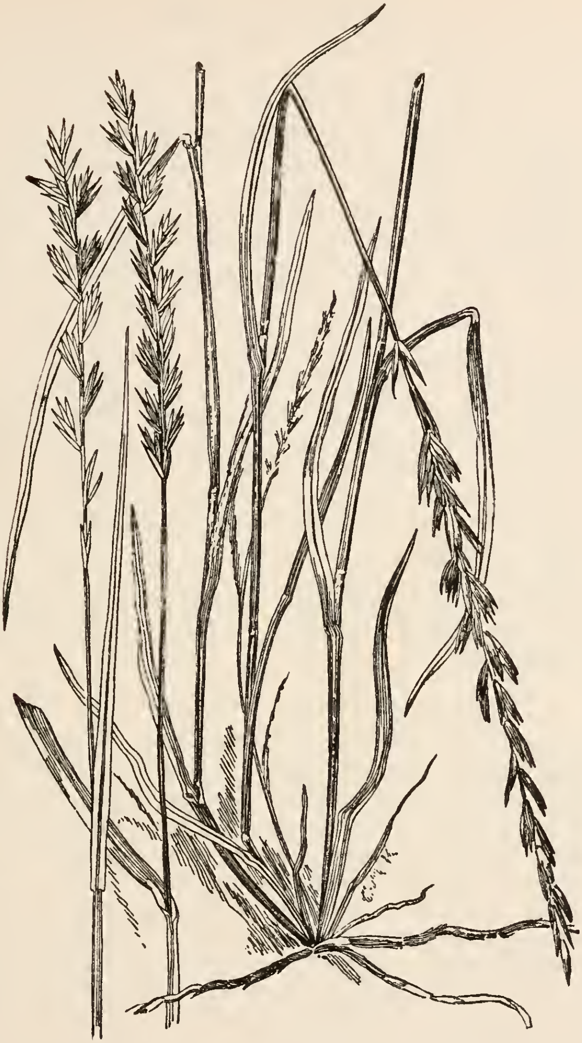


Fig. 154. Quackgrass (*Agropyron repens*). The "roots" (rootstocks) used in medicine. The roots contain considerable of a nutritious carbohydrate. (C. M. King.)

Medicinal properties. Quack grass is not known to be poisonous. The ancients since the time of Pliny have used the drug in medicine and it was also used by the Germans in the 10th century. The root stock is officinal. Gerard ascribed to the root diuretic, lithontriptic virtues or properties. The root contains considerable sugar and a substance called triticin, an amorphous, gummy substance easily transformed into sugar. It is found useful in the mucous discharge from the bladder. Quack grass and Western Wheat Grass frequently contain ergot.

12. *Hordeum*, L. Barley.

Annual or perennial grasses with flat leaves; cylindrical spikes; spikelets 1-flowered, with an awl-shaped rudiment on the inner side, 3 at each joint of the rachis of a terminal spike, the lateral ones usually imperfect or abortive and with a short stalk, empty glumes side by side in front of the spikelets, forming a kind of involucre; flowering glume and palet herbaceous, the former long and awned from the apex; stamens 3; styles very short; grain usually oblong and adherent to the palet; spike often separating into joints.

About 20 species widely distributed in both hemispheres. Of the Barleys, the 2-rowed barley (*Hordeum distichum*) and the 4-rowed barley (*H. vulgare*) are well known in cultivation, being used for malting purposes and occasionally in medicine. The awns of cultivated barleys produce mechanical injuries to stock. Several members of the genus are very troublesome weeds.

Four-Rowed Barley. Annual, 2-3 feet high, smooth; leaves linear-lanceolate, keeled, nearly smooth; sheaths striate, smooth, auricled at the throat; ligule very short; spikes 3-4 inches long, somewhat 4-sided; rachis flattened, pubescent on the margins; spikelets with 1 perfect floret; empty glumes, narrowly linear, pubescent, terminating in a slender awn; flowering glume 5-nerved, scabrous near the apex, long-awned; awn flattened, keeled, somewhat 3-nerved, serrulate on the margins.

The cereal is without doubt one of the most ancient of cultivated plants. It is supposed to have originated from *H. spontaneum* Koch, which grows wild in Asia Minor and Caucasian countries to Persia and Beloochistan as well as in Syria and Palestine.

Hordeum jubatum, L. Squirreltail Grass.

An annual or winter annual from 6 inches to 2 feet high producing fibrous roots, forming solid and compact bunches; leaves not unlike those of blue grass, but paler in color, from 2-4 inches in length, margins scabrous; flowers in dense spike from 2-4 inches long, pale green or purplish in color, consisting of a number of 1-flowered spikelets, 3 occurring at each joint, 1 being perfect (bearing stamens and pistil), 2 others awl-shaped, and borne on short stalks, 1 sterile spikelet occurring on each side of the perfect flower which bears a long awn; at each joint will be found 6 empty, long-awned glumes, spreading at maturity which give to the plant its bristly appearance; when mature, the spike breaks up into joints consisting of the rudimentary spikelets and a perfect flower, so that each joint has 1 "seed," the number of seeds in the spike varying from 35 to 60. A single cluster of plants may therefore produce from 300 to 2000 mature seeds. The plant has a wonderful capacity for "stooling." From a single plant as many as forty spikes may be produced and the number often no doubt exceeds this.

Distribution. It is found in marshes, in moist sand along the sea shore, and near the northern lakes. Its present distribution is from Nova Scotia to New Brunswick, along the Atlantic coast, Maine to Maryland and westward to the region of the Great Lakes, Minnesota, Saskatchewan and the Mackenzie river, the Dakotas, Iowa, Nebraska and the Rocky Mountain region, south to Texas, California and southern Mexico. It is also reported from Europe and Siberia.

Originally it was chiefly distributed in the Rocky Mountain region occurring in the saline soils of the plains, the great lakes and along the seacoast extending far northward. Its extension eastward and westward has taken place in the more recent times.

Hordeum secalinum, Schreb. Little Barley

An erect annual from 4-10 inches high, more or less geniculate at the lower end; sheaths smooth or upper often inflated; leaf blade 1-3 inches long; spikes narrow; empty glumes rigid, those of the central spikelet scarcely lanceolate, all awn pointed; flowering glume of the central spikelet awned or nearly so.

Distribution. Common and troublesome especially as far east as Missouri, Nebraska, British Columbia, and California.

Hordeum murinum, L. Wild Barley

An annual from 1-2 feet tall; erect or geniculate at the base; leaves rough; spikes from 2½-5 inches long; spikelets usually in 3's; scales awned, the empty glumes awnlike and scabrous, the second scale of the lateral spikelets not ciliate, the flowering glumes scabrous at the apex, bearing an awn about 1½-1¼ inches long.

Common on the Pacific coast and the dry regions of Utah, New Mexico, Arizona, and occurring on ballast in the Eastern states.

Mechanical injuries. It has long been known that the barbed awns of barley, wild barley and other plants act injuriously in a mechanical way. In the west this is especially true of wild barley (*Hordeum jubatum*).

Dr. S. H. Johnson, of Carroll, states in the Carroll Herald, that this grass, when found in hay and allowed to ripen, if in any quantity, is very injurious to horses' mouths. He says:

> The small awns seem to work in and cause deep ulcerating sores, which form under the tongue and lips. The writer has seen a large number affected and made a careful examination, and found the awns deep in the flesh, where they had remained for three months or more. I have seen lips eaten completely through and tongues eaten almost off by the grass. As to cattle, I have seen some affected, but not to any extent, because the mucuous membranes are much thicker. The sooner the grass is eradicated the better.

Professor Nelson, who has carefully studied this question, says on the injury to stock:

> The awned heads, when taken into the mouth ,break up into numerous sections, scatter within the mouth and everywhere adhere to the mucous membrane, which soon becomes pierced with the long stiff awns. As the animal continues to feed, more awns are added, and those already present are pushed deeper into the flesh. Inflammation soon results and leaves the gums of the animal in condition to be more easily penetrated. The awns are particularly liable to be pushed down and alongside and between the eeth. As the swelling and festering progress the awns are packed in tighter and pushed deeper and cause suppuration of the gums as well as ulceration of the jaw bones and he teeth. Through the absorption of the ulcerated sockets and roots the teeth become oosened and even drop out, but the animal, impelled by hunger, still endeavors to eat uch hay as may be offered.

The above statements apply largely to *H. jubatum*, but are equally true of all other species given above.

2. CYPERACEAE. Sedge Family

Grass-like, or rush-like herbs. Culms slender, solid or rarely hollow, frequenty triangular, terete, quadrangular or flattened; roots fibrous and, frequently, reeping rhizomes, leaves narrow, sheathes closed; flowers perfect or imperfect,

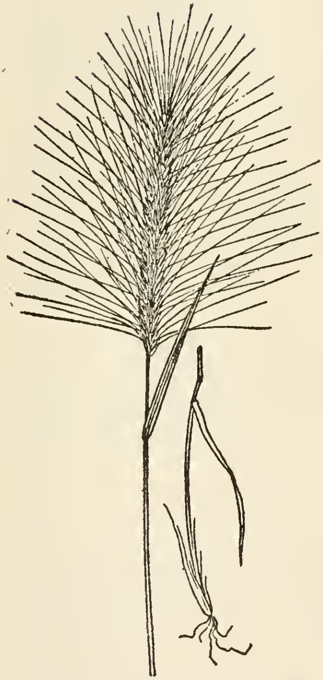


Fig. 155. Wild Barley (*Hordeum jubatum.*) Produces mechanical injuries to animals. (U. S. Dept. Agrl.)

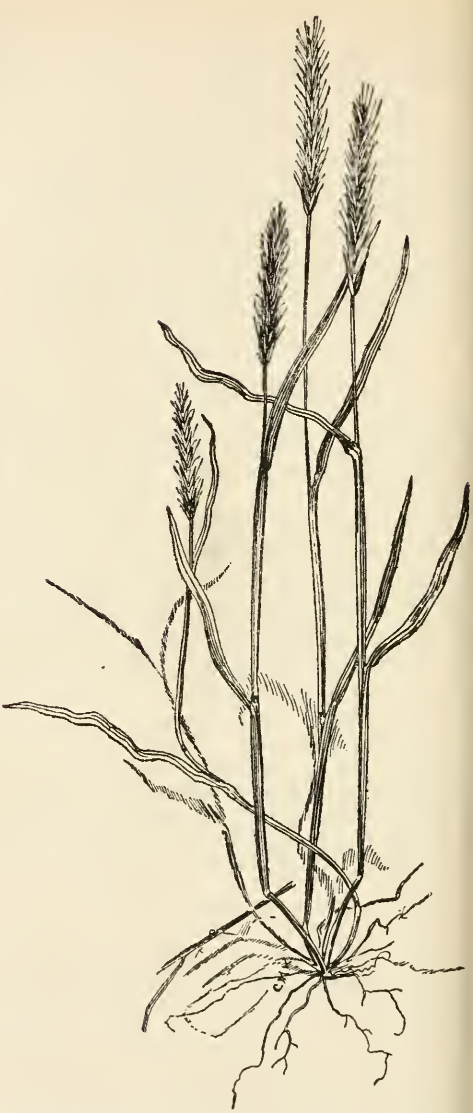


Fig. 156. Common Little Barley (*Hordeum secalinum*). Causes mechanical injuries. (Charlotte M. King.)

arranged in spikelets, 1 or 2 in the axil of each glume, spikelets, 1- many-flowered; scales 2-ranked, or spirally imbricated, persistent, or deciduous; perianth free, composed of bristles, scales or rarely wanting; anthers 2-celled; ovary 1-celled, ovule 1, erect style 2 or 3-cleft; endosperms mealy; embryo minute. A large family of comparatively few genera (65) and 3,000 species of wide distribution. Carex is found in colder regions, while Cyperus is in warmer regions. About 600 species of *Cyperus*, 200 of *Scirpus*, 200 of *Rynchospora* and 1,000 of *Carex*. The Papyrus (*Cyperus Papyrus*) of Africa and Sicily was used by the ancients as writing material. Common rush (*Scirpus lacustris*), a cosmopolitan plant found in water and marshes, is used for making mats and baskets. The rhizome of *Carex arenaria* is used in medicine.

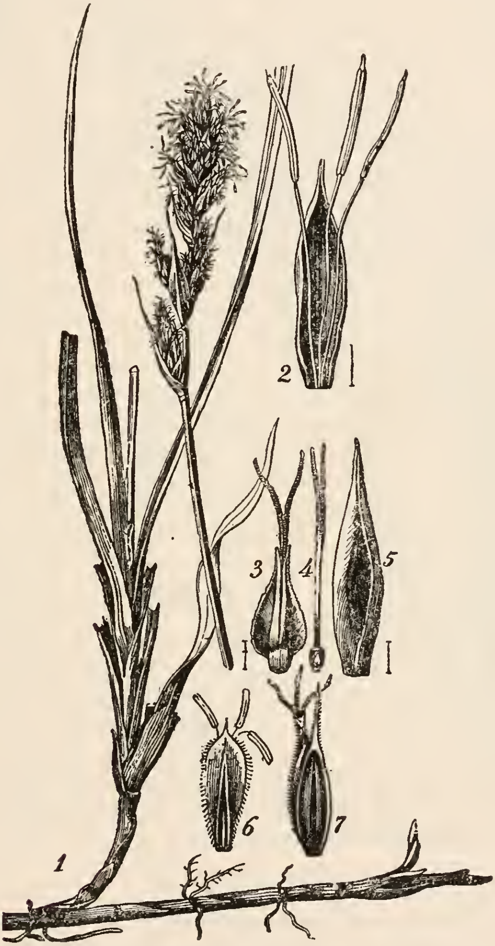


Fig. 157. Sedge (*Carex arenaria*). 1. Flowering plant. 2. Staminate flower with glume. 3. Pistillate flower. 4. Pistil. 5. Bract of pistillate flower. 6, 7. Staminate and pistillate flowers of *C. hirta*. (After Wossidlo.)

PRINCIPES

Woody or herbaceous plants with endogenous stems; flowers in spikes, generally on the plan of 3, free, regular or slightly irregular; stamens 3-9 or numerous but generally 6; ovaries, free, 1-7-celled usually; fruit dry or a fleshy drupe. Contains the family *Palmae*, a large family of 1,000 species, of which the most important palms are as follows: The date palm (*Phoenix dactylifera*) of Asia and North Africa, now cultivated in warmer regions of Europe, California and Arizona, and an important article of commerce in North Africa; the *Corypha* which furnishes sago, fiber, and a seed which is used as a substitute for coffee; and the Washingtonia of Southern California, frequently cultivated. Vegetable wax is derived from *Copernicia cerifera*. The wine palms (*Raphia vinifera* and *R. pedunculata* of eastern Africa), furnish raphia fiber. The *Metroxylon Rumphii* of the South Sunda Islands furnishes sago. The betel-nut palm (*Areca Catechu*) is much used as a narcotic, the poison derived from this being known as arecain, half a grain of which is sufficient to kill a rabbit in a few minutes. It acts upon the heart and influences respiration causing tetanic convulsions; it also causes a contraction of the pupil of the eye. It is used to some extent as a vermifuge and in India and the Islands of the Pacific it is applied as an external remedy. The nut contains the alkaloids, *arecolin, arecain, arecaidin*, and *guvacin*, which are used as vermifuges for dogs. The orange colored fruit is about the size of a hen's egg. When the nut is wrapped in quicklime and used, it imparts a red color to the saliva; it injures the teeth, and eventually destroys them. The resinous exudation from dragon's blood (*Daemonorops Draco*) of the East Indies is used in the manufacture of paints and varnishes. The oil from the oil palm (*Elaeis guineensis*) of West Africa and eastern South America is an important article of commerce. The cocoa-nut palm (*Cocos nucifera*) in tropical countries, especially the Islands of the Pacific, is an important article of food. The milk is the endosperm. The juice in the nut before maturity is unwholesome, being strongly diuretic and likely to cause serious results when taken into the system. A fermented drink is made from the juice of the plant which causes obesity and premature old age. A fiber known as ceir is made from the husks. Vegetable ivory (*Phytelephas macrocarpa*) of tropical countries, is a well known article of commerce. "Tuba" or Philippine toddy is made from the sap of the flowering spadix of *Nipa fruticans*. Toddy is also made from the juice of *Arenga pinnatus*, a plant which also furnishes an almost imperishable fiber. The "Royal Palm" is the "Yagua" (*Roystonea borinquena*) of Porto Rico, the sheathing bases of the leaves of which are used in thatching and siding the houses of the poor. An oil is produced from the husk and nut-like seeds of the *Acrocomia* or corozo palm which is distributed through tropical America from Mexico and Cuba to Paraguay.

SPATHIFLORAE

Mostly fleshy herbs with endogenous stems, or thalloid floating plants; flowers generally in a fleshy spadix subtended by a spathe or naked, or a few solitary flowers on the margin or back of the thalloid structure.

ARACEAE. Arum Family

Herbs with pungent juice; leaves with long, slender petioles and abounding in raphides; flowers borne in densely-flowered fleshy spadix, subtended or enclosed by the spathe; rootstock tuberous; floral envelopes none or of 4-6 sepals; stamens 4-10; filaments short; anthers 2-celled; ovary 1-several-celled; ovules 1-several in each cell; fruit a berry; seeds various, with 2 coats, the outer fleshy; endosperm abundant or none. About 900 species of wide distribution.

Many of the plants, as the skunk cabbage, *Symplocarpus foetidus*, possess acrid and noxious qualities. This is a native herb which is acrid and has a disagreeable odor. The fleshy spadix of *Monstera deliciosa* of the Mexican Cordilleras is edible. The vegetable calomel (*Acorus Calamus*) is used in nedicine and contains the bitter principle *acorin* and an alkaloid. The sweet alomel is poisonous, under some conditions, causing disturbed digestion, and, n severe cases, gastro-enteritis, persistent constipation, followed by diarrhoea nd passage of blood in the feces.

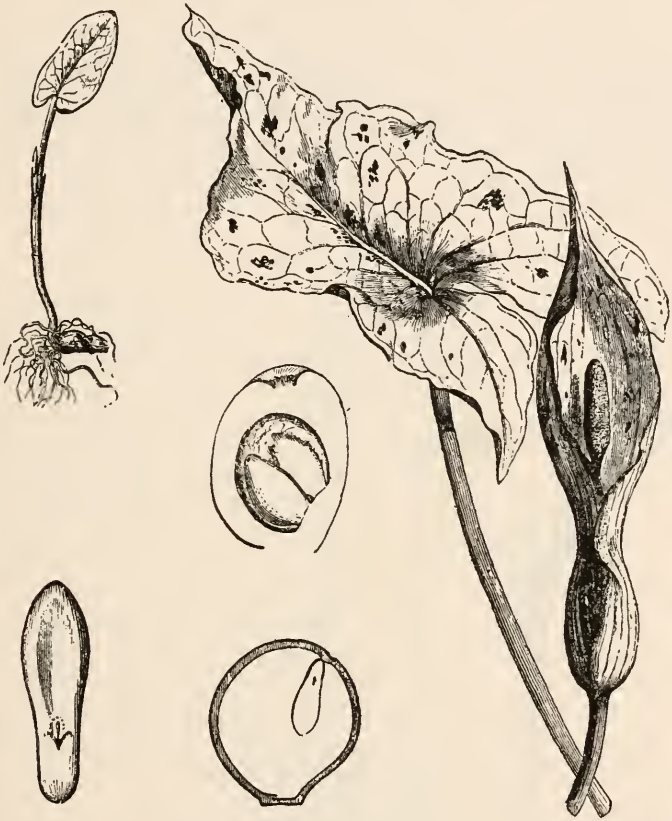


Fig. 158. Common European Arum, Cuckoo-pint, or Wake-robin (*Arum maculatum*). Leaf; spadix; longitudinal section of ovary; germination; longitudinal section of seed; embryo. (After Faguet.)

The *Calla palustris*, a marsh plant, has acrid properties and is used in apland with bread. The bulbs of *Amorphophallus* are rich in starch and are dible. The *Richardia africana* is frequently cultivated and used as food, a tarch being also made from it. The poisonous substances contained in it are emoved on roasting and boiling. In some of the fruits of aroids, like *Arum alicum*, *saponin* has been found, also needle-like crystals of oxalate of lime. . *maculatum* is poisonous and causes severe dermatitis, paralysis, and, in the case of children, even death. The *Thomsonia napalensis* of India, according to Major Kirtikar, is an acrid poison but its deleterious properties may be removed by roasting. The arrow arum (*Peltandra virginica*) of eastern North America is an irritant.

Arisaema. Mart.

Perennial herbs with tuberous rootstock or corm, having acrid properties; leaves simple or compound, scape simple; spathe convolute, generally arched above; spadix with flowers near the base; floral envelopes none; flowers monoecious or dioecious; stamens 4; anthers 2-4-celled; pistillate flowers with a 2-celled ovary containing many ovules; fruit a globose, red berry; seeds with copious endosperm. About 50 species found in temperate climate.

Arisaema triphyllum. (L.) Schott. Indian Turnip

Corm turnip-shaped, farinaceous; leaves generally 2, divided into 3-foliate leaflets, ovate; spadix mostly dioecious, club-shaped, much shorter than the arched spathe, which is green and purple striped: ovules 5-6; berries shining, forming a dense head. The dragon head (*A. Dracontium*) with solitary leaf pedately divided into 7-11 oblong lanceolate leaflets, and spadix tapering to a long slender point, is common in rich woods from Minnesota and Iowa, eastward.

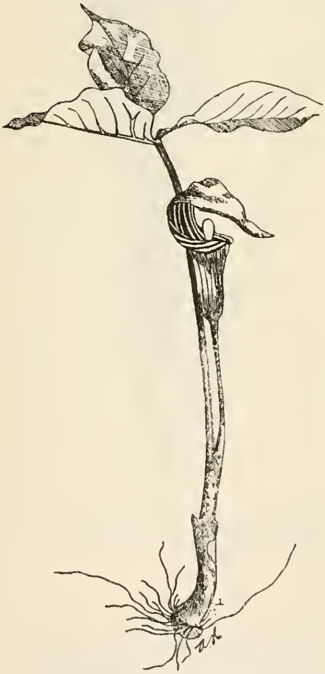


Fig. 159. Indian Turnip (*Arisaema triphyllum*). A common plant of our woods. Corm contains an acrid poison.

Distribution. The Indian Turnip occurs in moist woods from Kansas and Minnesota to Nova Scotia and Florida.

Poisonous properties. The corm of Indian Turnip is so extremely acrid that a decoction made from it has been used to kill insects.

The family *Lemnaceae* is allied to the *Araceae*. It contains the Duckweeds, (*Lemna*).

FARINOSAE

Herbs with endogenous stems and mostly narrow leaves; flowers usually complete, parts usually in 3's or 6's; corolla regular or nearly so; ovary compound, superior; endosperm of the seed mealy. This series contains the *Xyridaceae*, of which the yellow-eyed grass is an example; the *Eriocaulaceae*, of which the pipewort (*Eriocaulon septangulare*) of the Atlantic seashore is a good illustration; the pine-apple family (*Bromeliaceae*) of 350 species, in tropical and warmer regions, represented in the south by the Spanish moss (*Tillandsia usneoides*) which hangs in long festoons from trees, and by the pine-apple (*Ananas sativus*), a well known fruit now cultivated extensively in Florida; from which has been isolated the enzyme, *bromelin*, a powerful ferment capable of rapidly digesting vegetable and animal albumen. It acts in the presence of either acid or alkaline carbonates and is related to *trypsin* and *pepsin*. In the same family is the pinguin (*Bromelia Pinguin*) or wild pine-apple, the slightly acrid pulp of which is edible and the fiber valuable. The plant is armed with stout spines which made the passage of troops difficult in the late Spanish war.

In the same order are the Spiderworts belonging to the family *Commelinaceae*. The common blue spiderwort (*Tradescantia virginiana*) of sandy and

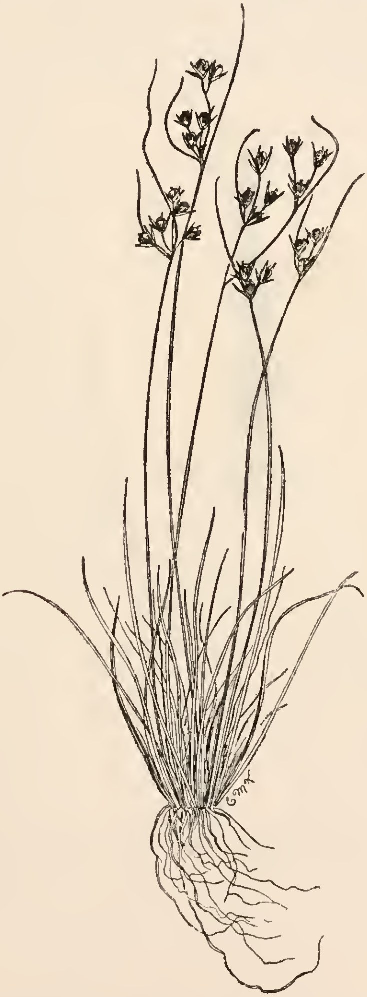


Fig. 161. Common Rush (*Juncus tenuis*). A weed with tough stems, along beaten paths and roadsides. (Charlotte M. King.)

gravelly soils, has mucilaginous stems, blue ephemeral flowers, and is common everywhere in eastern North America. Several species of *Tradescantia*, like the wandering Jew (*T. Zebrina*), are commonly cultivated. Another family of the order is the *Pontederiaceae*, containing the pickerel weed (*Pontederia cordata*) and the *Eichornia speciosa*, which is frequently cultivated in greenhoses and has become a very troublesome weed in the rivers of Florida and elsewhere in warm countries.

LILIIFLORAE

Herbs or occasionally shrubs with endogenous stems and monocotyledonous seeds; perianth generally well developed; flowers generally regular and complete, their parts in 3's and 6's; ovary superior, or inferior compound; endosperm horny or fleshy. This series contains the family *Juncaceae*, called rushes, some of which, like wire-grass (*Juncus tenuis*), are troublesome weeds. *Luzula* is common at high altitudes and in northern states.

The *Dioscoreaceae*, or Yam Family, contains but few species in the United States. To this belong the wild yam root (*Dioscorea villosa*) of our woods, the Japanese yam (*D. divaricata*) and the air potato (*D. bulbifera*) of Asia, sometimes cultivated in the Gulf States for its large tubers. Yam starch is obtained from several species, the most important of which are *D. alata, D. sativa, D. japonica,* and *D. aculeata.*

The family *Taccaceae* contains *Tacca pinnatifida*, the roots of which are the source of the Tacca starch of Tahiti and the neighboring islands. The plant is grown also in Brazil and India.

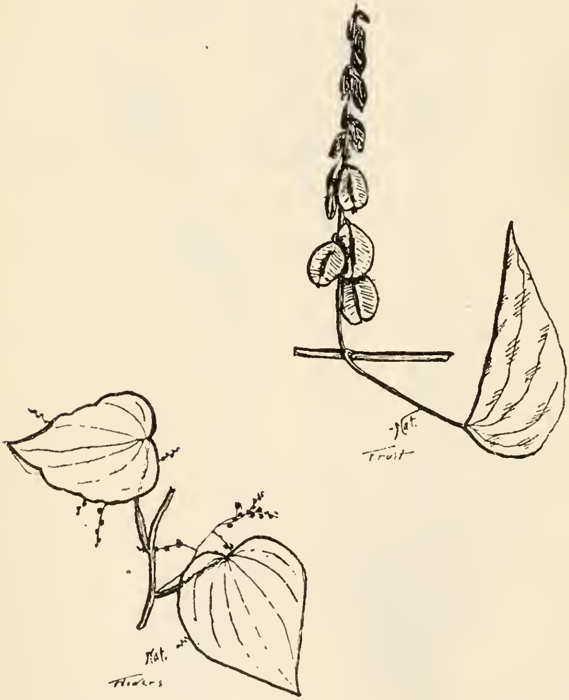


Fig. 160. Flowers, fruit and leaves of Yam (*Dioscorea villosa*). A common plant in thickets.

FAMILIES OF LILIIFLORAE

Ovary mostly superior.
  Perianth segments distinct or partly united, the inner, petal-like;
    fruit a capsule or berry..Liliaceae

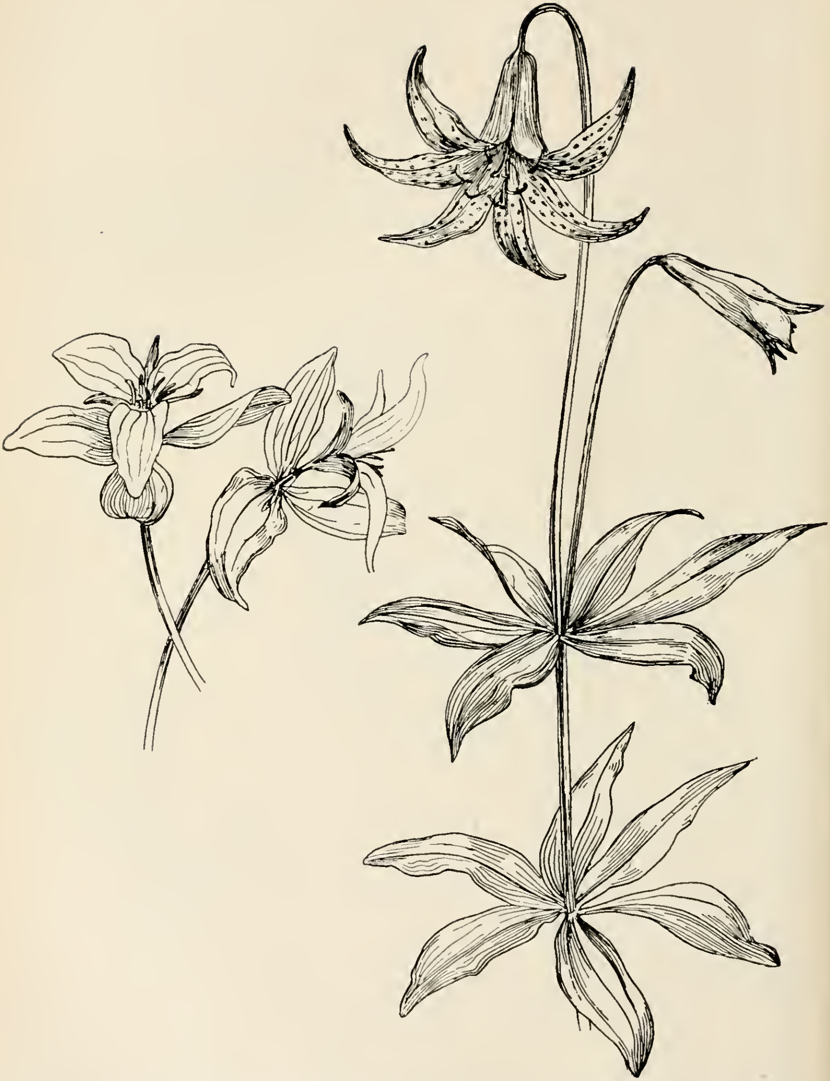
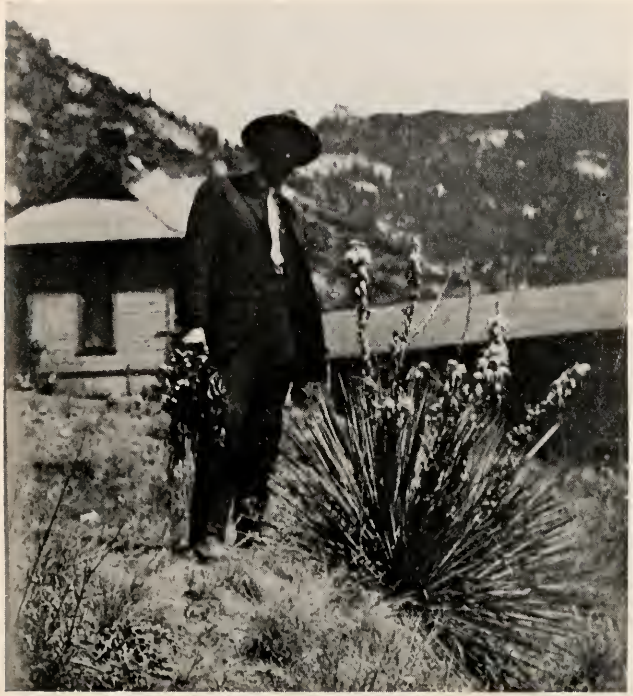


Fig. 161. Wake Robin (*Trillium nivale*); Canada Lily (*Lilium Canadense*). The Trilliums are considered poisonous. (C. M. King).



A. Yucca (*Yucca angustifolia*). An ornamental plant thought to contain a poisonous alkaloid. (L. H. Pammel).

B. Greasewood and Tetradymia. (L. H. Pammel).

Ovary inferior, at least in part.
  Stamens 3, opposite the inner segments....................Haemodoraceae
  Stamens 6.
    Erect perennial herbs; flowers perfect................Amaryllidaceae
  Stamens 3, opposite the outer segments........................Iridaceae

I. LILIACEAE. Lily Family

Herbs or rarely woody plants with regular, symmetrical flowers; perianth not glumaceous; 3 sepals; 3 petals; 6 stamens; ovary 3-celled; fruit a pod or berry; embryo enclosed in the hard albumen. A family of about 1,600 species, including among others, several ornamental plants like the lily, lily of the valley, and yucca; some medicinal plants like squill, aloe, and false hellebore; and several poisonous plants like death camas and colchicum, the latter, native to Europe and Africa. The fatal poisonous nature of *Colchicum* was familiar to the ancients, it being known to contain several poisons, such as the alkaloid *colchicin* $C_{22}H_{25}NO_6$, an amorphous, yellowish white gum, chiefly an alkaline bitter substance, which, on boiling with acids, yields *colchicein* $C_{21}H_{23}NO_6$, and a yellowish green resin.

Animals that eat the plant suffer with acute gastro-enteritis, coma, staggering, weak pulse, and increased urination. The family also includes several economic plants like the onion (*Allium Porrum*); garlic (*Allium sativum*); chives (*A. Schoenoprasum*); shallot (*A. ascalonicum*); hyacinth (*Hyacinthus orientalis*); New Zealand flax (*Phormium tenax*), native to New Zealand where it occupies much of the country, and is now used in large quantities for making ropes and mats; (*Yucca filamentosa*) and (*Y. augustifolia*), the former a well known plant of the South and the latter a well known plant of the West, both species frequently cultivated for ornamental purposes, a large number of other species of the genus *Yucca* being also found in the Southwest. The day lily (*Funkia subcordata*), several species of the tulip (*Tulipa*), and several species of *Lilium* are cultivated. Perhaps the most common in the old gardens is the tiger lily, (*L. tigrinum*). Several species of the aloes are common in cultivation in greenhouses. They are also medicinal, containing the substance *aloinum*, a neutral principle, which yields *barbatorin* $C_{17}H_{20}O$. Aloes are cathartic. The California or Mariposa lily belongs to the genus *Calochortus*. The asparagus (*Asparagus officinalis*) is cultivated and is a well known vegetable. The cultivated smilax (*Asparagus medeoloides*) is a native to the Cape of Good Hope. The dragon-tree (*Cordyline terminalis*) is frequently cultivated. Some of the species of the latter like "Ti" of the Sandwich Islands are of economic importance. The roots of "Ti" contain a saccharine matter, from which the natives extract sugar; they also bake the roots and eat them. The remarkable dragon-tree of the Canaries is noted for its large circumference and comparatively low height. The Botany Bay resin (*Xanthorrhoea hastilis*) is chiefly used as a shellac for making colored varnishes.

Yucca leaves contain salicylic acid. Several investigators have reported *saponin* in the roots of *Yucca filamentosa*, *Y. augustifolia*, and *Y. imperialis* contain the alkaloid *imperialin* $C_{35}H_{60}NO_4$. In the former, Dr. Helen Abbot Michael reports the presence of several resins, the amount varying from 8-10 per cent in the root. She regarded the *saponin* as a constructive glucoside which served to unite what are known as the *Saponin* groups. *Saponin* occurs in many different plants, especially in the *Sapotaceae*.

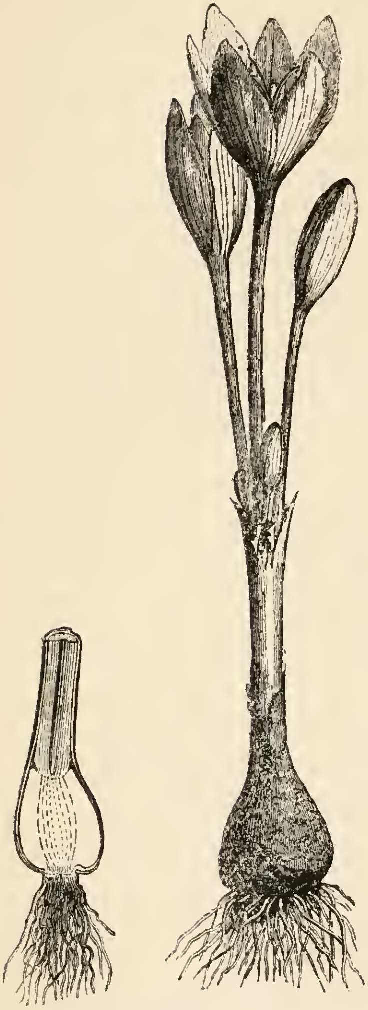


Fig. 162. Colchicum (*Colchicum autumnale*). Flowering plant and longitudinal section of stem and bulb. Faguet.

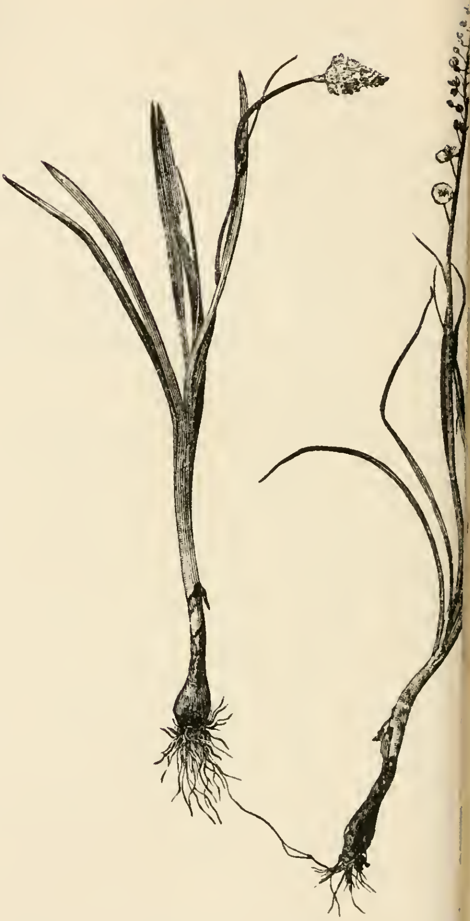


Fig. 163. Camas plant or Death Camas (*Zygad us venenosus*). A western plant, extremely poisonou to sheep.

The fly poison (*Amianthium muscaetoxicum*) is a smooth plant with simple stems from base; broadly linear leaves; white flowers in simple racemes; widely spreading perianth without claws or glands. Occurs from Long Island to Florida to Arkansas. It is a well known fly poison of the south. It is related to *Veratrum* and *Melanthium*.

The *Bulbine bulbosa*, of Australia, is poisonous to cattle, sheep and horses, which, after eating it, display such symptoms as lying down, rolling continually, having scours and a mucous discharge from the nose. The tuberous herb, *Gloriosa superba*, of India, according to Major Kirtikar, is a violent emetic;

the roots of this, when eaten, produce death in four hours. It is said to contain the bitter principle *superbin* ($C_{32}H_{60}N_2O_{17}$), perhaps identical with *scillotoxin*. The leaves and roots of *Paris quadrifolia* of Europe have a bitter taste. The berries are said to poison chickens and to produce gastro-enteritis in man. The *Aloe succotrina* contains from 4-10 per cent of a bitter principle *aloin*, also some *emodin*. Representatives of the genus *Scilla* and *Urginea* yield *scillipicrin*, *scillin*, and *scillotoxin*, the latter of which resembles *digitoxin*; the first of these acts upon the heart; where used as an emetic, it has proved fatal because of its irritant action on the intestines. The seeds of *Sabadilla officinalis* are used as a parasiticide. They contain *cevadin* $C_{32}H_{49}NO_{11}$, *cevadillin* $C_{34}H_{53}NO_8$, and are the principal source of *veratrin* $C_{32}H_{55}NO_{11}$, and the glucoside *scillain* or *scillitin*. According to Friedberger and Fröhner animals poisoned with "rat poison" (squill) had cerebral convulsions and erysipelas. The rhizome of Solomon's Seal (*Polygonatum giganteum*) has an acrid bitter taste.

Chickerinchee (*Ornithogalum thyrsoides*) is reported by Dr. Liautard (1) to have been the cause of acute gastro-enteritis in horses in South Africa. The species O. *Muscari* may possibly be poisonous since it is allied to the above which an African veterinarian reports to be poisonous. The Star-of-Bethlehem (O. *umbellatum*) which is a pretty cultivated garden plant in the northern United States has become an escape in Kentucky and is regarded as a rather troublesome weed. The Tulip and Fritallaria are also poisonous.

GENERA OF LILIACEAE

Perianth bell-shaped, gamophyllous.
Fruit a berry..5. Convallaria
Perianth cleft or divided.
Fruit a berry ....6. Trillium
Fruit a capsule.
With scarious bracts....................................4. Allium
Without scarious bracts.
Roots bulbous ....1. Zygadenus
Roots not bulbous.
Sepals with claws, free from the ovary.........2. Melanthium
Sepals without claws...........................3. Veratrum

1. *Zygadenus*. Michx. Camas

Smooth, erect, perennial herbs from bulbs or rootstocks; leaves linear; greenish or white flowers in panicles; stamens free from perianth segments; capsule 3-lobed and 3-celled. A small genus of about 8 species, native to North America and Mexico.

Zygadenus venenosus. Wats. Death Camas

A pale green, slender perennial, 6 inches to 1½ feet high, from small coated bulb; leaves rough, somewhat shorter than the stem; flowers borne in a raceme, yellowish or yellow, polygamous; segments of the perianth ovate or elliptical, free from ovary, bearing a roundish gland; capsule much larger than the perianth.

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(1) Am. Vet. Rev. 30:298.

Distribution. From South Dakota to Nebraska, Colorado, Utah, California, Montana and British Columbia.

Zygadenus chloranthus. Pursh. Smooth Zygadenus

A glaucus perennial 1-3 feet high, coming from an elongated bulb; leaves flat; flowers borne in racemes, few flowered, greenish; segments of the perianth oval or obovate, united below and adnate to the base of the ovary; capsule longer than the perianth.

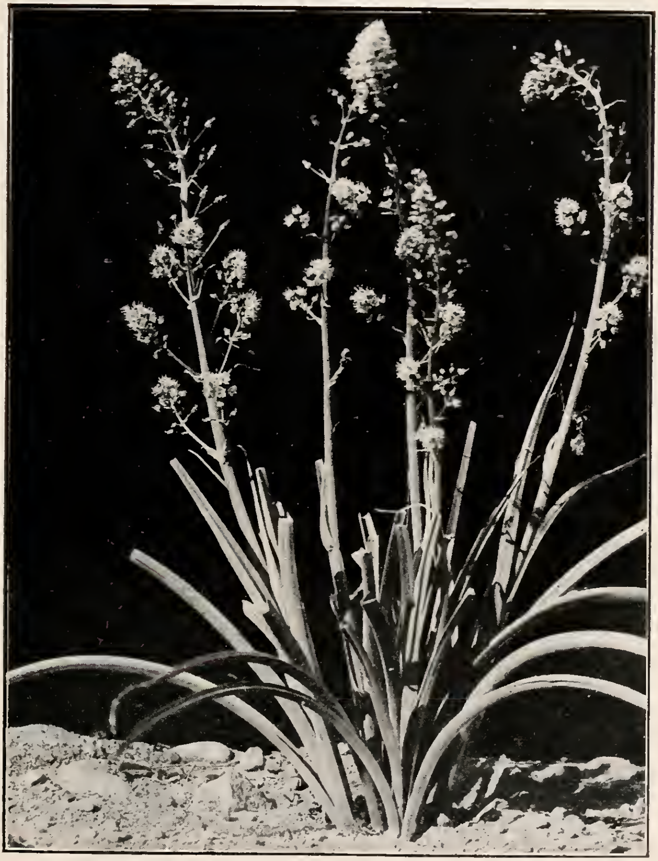
Distribution. Common especially northward in Iowa and Minnesota to Alaska, in the Rocky Mountains to New Mexico and east to Missouri. It may also be poisonous.

Poisonous properties. Mention of the poisonous nature of the various species of Zygadenus has frequently been made, especially by the early explorers, the poisonous bulbs encountered by them being referred to as poison camas or poison sago, so called to distinguish them from the edible Quamasa, which is commonly called kamas. These species bear essentially the same name today, except that in some places they are also called Lobelia. The bulbs are apparently much more poisonous than the leaves, but if the ground is very dry, sheep are less likely to pull them up than when the ground is moist. After rains, however, or early in the spring it is possible that some of the bulbs may be pulled up and thus eaten by sheep. In Montana, according to Chesnut and Wilcox, large numbers of sheep are killed by eating death camas. These authors state that in one band two thousand were poisoned and one hundred of these died. In another band two hundred were poisoned and ninety died.

Prof. Hillman reports that the wild sago (*Z. paniculatus*) is probably responsible for the death of a considerable number of cattle in certain alkaline districts in Nevada. Dr. S. B. Nelson, in experimenting with this species had wholly negative results. He fed one pound of the plant in blossom and fruit to sheep. Dr. Wilcox and Prof. Chesnut made tests on rabbits and sheep with extracts and fresh plants, and in every instance obtained positive evidence of poisoning. In these instances the plants were not in flower. Prof. Chesnut says stock is poisoned while pasturing by eating the bulbs along with the leaves or the leaves alone, or by the seeds when present in hay, as they sometimes are. Stock, especially sheep, are usually killed by eating the plant before it has blossomed in the spring. Cases of poisoning are so common in Oregon and Nevada that the term "lobeliaed" has been used to indicate the result from this kind of poisoning.

According to Chesnut and Wilcox the symptoms of poisoning are remarkably uniform:

> The first signs of poisoning are a certain uneasiness and irregularity in the movements of the sheep These irregularities rapidly become more and more pronounced, accompanied by incoordination of the muscular movements, spasms and rapid breathing. Although sheep are highly excited under the influence of Zygadenus poisoning, the cerebral symptoms seldom constitute a condition of frenzy. It was readily observed that until a few minutes before death ewes were able to recognize their lambs, and indicate in other ways that they were not in any sense crazed. The later symptoms were those of complete motor paralysis, combined with an exceedingly rapid and sharp breathing and a frequent weak pulse. The duration of these different stages of poisoning varies to a considerable extent, and depends entirely upon the amount of death Camas which the sheep had eaten.



Death Camas (*Zygadenus venenosus*). A poisonous plant of the western United States. (Nev. Agr. Exp. Sta.)

Postmortem examinations made show that in every instance the lungs were congested with blood, being a hepatized condition. There were no lesions in the membranes of the brain. In cases of adult sheep the effect upon the digestive organs was not marked. There were usually to be noticed an increased salivation and continued regurgitation through the mouth and nostrils. "Symptoms produced experimentally by feeding the death camas to sheep were the same as those characterizing natural poisoning by this plant.

The toxic substance has not been isolated. Chesnut and Wilcox observed that the ground material macerated with luke warm distilled water produced a substance that had a decided soapy feeling, and that the pure juice was distinctly irritating when left on the hands for several minutes. The physiological action of the Veratrum is somewhat similarly caused by the active poisonous principle in camas. It is probable that many of the Melanthaceae have similar properties. Dr. Wilcox recommends, in case of poisoning by death camas, the hypodermic injection of strychnin in 1/20, 1/10 and 1/5 grain doses, the hypodermic injection of atropin in 1/60 and 1/30 grain doses, and solutions of potassium permanganate and aluminum sulphate. From 5 to 10 grains of each of these compounds are dissolved in water and given as a drink to adult sheep. Hogs take the same doses as sheep, horses from 15 to 20 grains, and cattle from 30 to 50 grains. Occasionally the material is injected directly into the stomach, but ordinarily the more convenient method is to allow the animals to drink it. The substances *veratalbin, sabadin* and *sabadinin* have been obtained from *Z. venenosus.*

2. *Melanthium.* L. Bunchflower

Perennial tall leafy herbs with a thick rootstock; leaves linear to oblanceolate; flowers on large panicles, monoecious or polygamous, greenish yellow; perianth of 6 widely spreading segments raised on slender claws free from the ovary; stamens shorter than the perianth; pistil with 3 styles; capsule 3-lobed and 3-celled. A small genus of 4 species, in eastern North America.

Melanthium virginicum. L. Common Bunchflower

Tall leafy stemmed plants 3-5 feet high; leaves linear, the lower sheathing, the upper similar and sessile; flowers in an ample panicle, fragrant; perianth of flat segments, greenish yellow; styles persistent, capsule 3-celled; 8-10 seeds in each cavity.

Distribution. In low meadows and prairies from New England to Iowa river basin to Minnesota to Texas and Florida.

Poisonous properties. Several correspondents in Iowa have attributed poisoning of horses to this plant. Several related plants of the *Melanthaceae* like *Zygadenus* and *Veratrum* are known to be poisonous.

Mr. J. R. Campbell, of Blockton, Iowa, writes us the following:

> The specimens I sent you, and which you have identified as *Melanthium virginicum,* have been the reputed cause of a number of cases of poisoning here this summer. The veterinarian here pronounced it aconite poisoning as the symptoms are similar, but he decided this weed caused it as it has been found present in every case. In the first cases that he noticed here nearly all the horses in the livery barn were attacked after partaking of hay which contained an abundance of the matured seed pods of this plant. None of the animals died. The liveryman then had his men pick out all the weed, and he has not been troubled since. Several cases have occured at different places since then, all traceable to this weed.

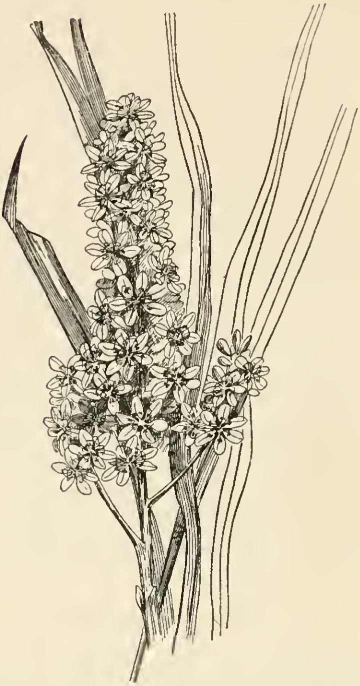
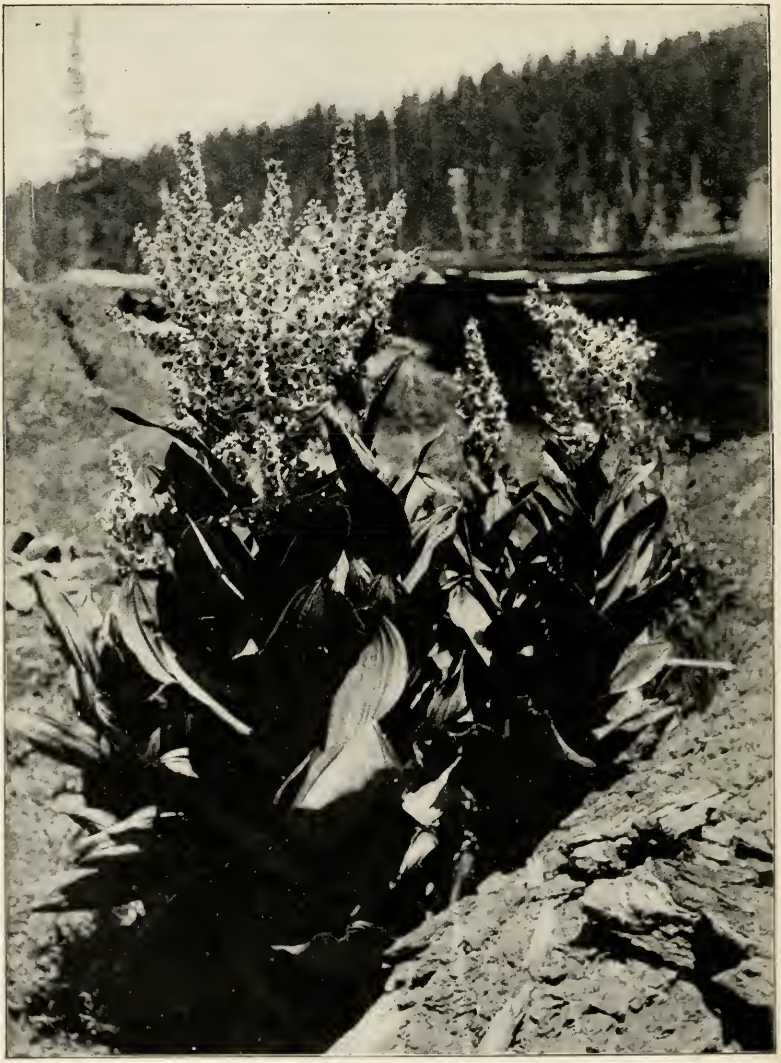


Fig. 164. Bunch flower (*Melanthium virginicum*). Common in low meadows Eastern Iowa and southward. Often mixed with hay and causes poisoning of horses. (Charlotte M. King.)

At the place where I obtained these specimens the owner said he had cut the meadow and fed hay off it for fifteen years and never had any trouble until this year. Hay cut last fall seems to contain the poison; seed heads were fully mature; meadow is low and wet.

The following are the symptoms as described by the veterinarian: Heart fast and very weak; respiration shallow and labored; great muscular weakness; retching, considerable slobbering, some sweating; temperature was normal. The effect lasted three or four hours, and the animal was stupid and lacked appetite for one or two days afterwards.

The disease stopped when a ration of hay containing none of this weed was fed. Since writing the above, Dr. Blanche, a veterinarian in Belle Plaine, this state, found that horses fed with hay containing this plant "became ill and acted as if they were crazy. The symptoms were much like those from aconite poisoning." These bunchflowers have long been used to poison flies, and Hyams, of North Carolina, says that they are poisonous to crows. The *M. latifolium* and *M. pariflorum* have similar properties. According to Chesnut the Indians of Mendocino County, California, use the soaproot or Yuki (*Chlorogalum pomeridianum*) to stupify fish. This plant is closely related to *Melanthium*.



Wild Indian Corn: Swamp Hellebore (*Veratrum californicum*). Reported to be poisonous to cattle and horses. (Bull. Nev. Agr. Exp. Sta. 51).

3. *Veratrum* (Tourn.) L.

Perennial herbs; leaves broad, clasping, veined, and plaited; flowers in large panicles, greenish, polygamous or monoecious; perianth in 6 parts, spreading, greenish or brownish, without glands or nearly so, and not clawed; stamens short and free, ovary with 3 persistent styles, capsule 3-lobed, 3-celled and several-seeded. A small genus of 10 or 11 species distributed in north temperate regions. One species used in medicine; all are poisonous.

*Veratrum viride, A*it. American White Hellebore

A stout, leafy perennial from 2-7 feet high, with fleshy root, 1-3 inches long; flowers in ample, dense, spike-like racemes; it blooms from May to July.

Distribution. Common in swamps and wet woods, especially in eastern North America, west to Wisconsin, south to the mountains of Georgia, and north to Alaska.

Veratrum californicum, Durand. California Hellebore

A stout perennial from 2-8 feet high, fleshy root, flowers in a large loose terminal panicle; perianth segments whitish with long and narrow floral leaves.

Distribution. Common in the mountains of California and the Rocky Mountains as far north as British Columbia, south to New Mexico.

Poisonous Properties. Prof. Chesnut says:

> Cases arise mainly from overdoses in medicine, but instances of accidental poisoning are reported for man and for various animals and birds. In one case all the members of a household were poisoned by eating the young leaves, which were mistaken for those of marsh marigold (*Caltha palustris*) and prepared for food. Animals do not relish the plant, which is acrid and burning in the fresh condition, but young aimals sometimes eat it with fatal results. The roots are not often mistaken for those of edible plants, but being fleshy and especially rich in alkaloids, they are somewhat dangerous. The seeds have been eaten by chickens with fatal results. The general effect is very much like that of aconite (*Aconitum Napellus*), being directed chiefly against the action of the heart and spinal cord, both of which tends to paralyze.

The symptoms of the poison are burning in the throat with increased salivation, producing a weak pulse, labored respiration and profound prostration. The root was used by the Indians in making snuff. Dr. Halsted attributed deaths of human beings as well as of cattle in New Jersey to this plant.

The number of poisonous substances found in hellebore is quite large. Of these so-called *veratrin,* $C_{32}H_{19}NO_{11}$, of earlier writers, has an alkaline reaction, and a burning taste; it produces violent sneezing and dilates the pupil. However, later investigators have separated this into the following bases: the very toxic *cevadin,* $C_{23}H_{49}$–09, *veratridin,* $C_{37}H_{53}NO_{11}$ and *sabadillin* $C_{34}H_{53}NO_8$.

Veratrum album, L., *V. lobelianum* Bernh., *V. viride,* Ait., also contain in addition to the bases named above, two other bases, *sabadin,* $C_{29}H_{51}NO_8$, and *sabadinin,* $C_{27}H_{45}NO_8$, and also the following substances: *jervin* $C_{26}H_{37}NO_3$, a pure alkaloid *rubijervin* $C_{26}H_{43}NO_2$, *pseudojervin* $C_{29}H_{43}NO_7$, *protoveratrin*

$C_{32}H_{51}NO_{11}$, *protoveratridin* $C_{26}H_{45}NO_8$, and the bitter glucoside *veratamarin.* *Jervin* is a powerful depressant to the heart muscles and vaso motor centers; large doses therefore weaken the pulse. It depresses respiration and death occurs from asphyxia. Dr. Winslow, in speaking of the toxicology, says:

> The symptoms exhibited in *Veratrum viride* poisoning are: salivation, vomiting, or attempts at vomiting, purging, abdominal pain, muscular weakness, difficulty in progression, loss of power and general paralysis, muscular tremors and spasms, and, occasionally, convulsions. The pulse is unaltered in rate at first, but later becomes infrequent and compressible and finally rapid, threadlike and running. The respiration is shallow, the temperature is reduced, the skin is cold and clammy; there is semi-consciousness, loss of sight, and death from asphyxia. Treatment should be pursued with cardiac and respiratory stimulants, as amyl nitrite (by inhalation), alcohol, strychnin and atropin; tannic acid as a chemical antidote; opium to subdue pain, and demulcents to relieve local irritation of the digestive tract. Warm water should be given the smaller animals to wash out the stomach and to asist vomition, and quietude should be enforced. In man, fatal poisoning is rare, since the drug is spontaneously vomited. The same would probably apply to dogs. Recovery has ensued in horses after injection of two ounces of veratrum album root.

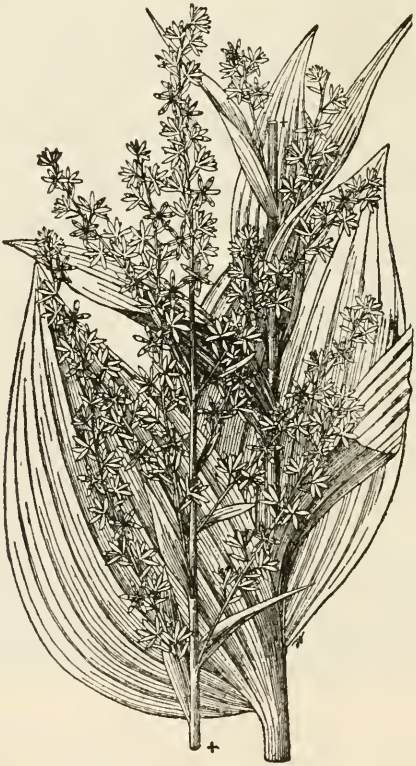


Fig. 164a American White Hellebore (*Veratrum viride*). A poisonous plant of Eastern North America.

4. *Allium* (Tourn.) L. Onion, Garlic and Leek

Perennial bulbous plants, bulb solitary or clustered, leaves generally linear, a few lanceolate or oblong; stem simple or erect; flowers in umbels subtended by bracts; perianth white, purple or pink, the parts distinct or united at the base often becoming dry; the 6 filaments awl shaped, ovary 3-celled or incompletely so; capsule with 1-2 black seeds in each cell. About 275 species of wide distribution; contains a number of important economic plants, among them garlic (*A. sativum*), garden leek (*A. Porrum*), chives (*A. Schoenoprasum*), shallot (*A. ascalonicum*), onion (*A. Cepa*), and the golden garlic (*A. Moly*), cultivated for ornamental purposes.

Allium vineale, L. Field Garlic

A slender scape, naked from an ovoid membranaceous bulb; 1-3 feet high; terete and hollow leaves, channeled above, frequently densely bulbiferous; flowers greenish or purple.

Distribution. Common in meadows and wheat fields of Virginia, and eastern states from Connecticut to Virginia and Missouri. Naturalized from Europe.

Allium tricoccum Ait. Wild Leek

Scape naked, 4-12 inches high from an ovoid bulb; leaves fibrous articulated; leaves oblong, lanceolate or elliptical, few, appearing long before the flowers in spring; flowers in umbels numerous, greenish white, one ovule in each cavity; capsules strongly 3-lobed; seeds black and smooth.

Distribution. Common in the woods from western New England to Minnesota and Eastern and northern Iowa, especially in the low damp grounds.

Allium canadense L. Wild Garlic

Scape 1-2 feet high, coming from an ovoid bulb, the outer coats fibrous reticulated; leaves narrow linear; flowers in an umbel frequently with small bulbs; flowers pink or white.

Distribution. Common in meadows or low grounds in New England to Minnesota and Iowa, south to the Gulf.

Injurious Properties. In parts of the country where these onions grow there is frequent complaint of milk taking the flavor of onions where cattle feed upon them. Chesnut and Wilcox do not mention any species of the genus *Allium*, except some of the species found in Montana, which may impart to milk a disagreeable flavor. Friedberger and Fröhner state that onions produce slavering.

Prof. A. Liautard * has prepared an abstract of a report by Dr. W. W. Goldsmith in the Journal of Comparative Pathology and Therapeutics upon onion poisoning in cattle. Briefly it is as follows:

> Loads of onions partly started to shoot and partly decayed, were unloaded in a meadow where nine head of cattle were grazing. After a week the cattle seemed sick

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* Amer. Vet. Review. 36:63

and one died, displaying the following symptoms: Intense onion odor, tucking up of flanks; constipation in some; purging freely in others; one vomited abundantly; another very ill, grunted, was much constipated, staggered in walking, was very tender in loins, temperature 103°, urine dark and smelling of onions. Treatment: Feeding with soft food and hay. Large doses of linseed oil. One animal that was very ill got also extract of belladonna and carbonate of soda. All but one of the animals recovered. At the autopsy of the dead one, the rumen was found inflated and also the bowels. Liver enlarged and of light color. Kidneys dark green and with offensive odor. Rumen contained large quantity of onions and grass. The whole carcass and organs smell of onions.

5. *Convallaria* L. Lily of the Valley

A low smooth herb with horizontal root-stocks; flowers white in a one sided raceme; stamen 6; ovary 3-celled; berry globose. A genus with one species.

Convallaria majalis, L. Lily of the Valley

A smooth perennial herb with horizontal root-stocks and 2 or sometimes 3 oblong leaves; flowers in racemes; perianth bell shaped, white, 6-lobed, stamens 6, inserted on the base of the perianth; ovary 3-celled, 4-6 ovules in each cell;

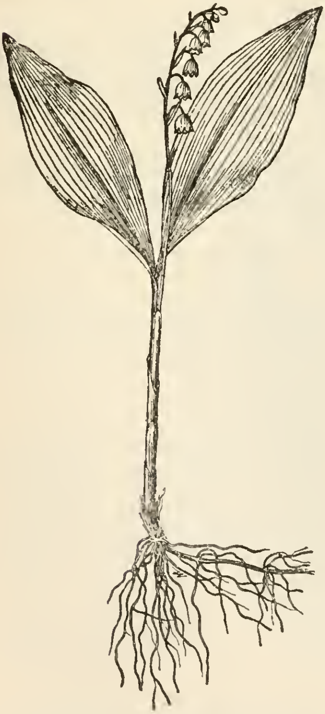

Fig. 165. Lily-of-the-Valley (*Convallaria majalis*). A well known cultivated plant possessing poisonous properties similar to those of Foxglove. U. S. Dept. Agr.

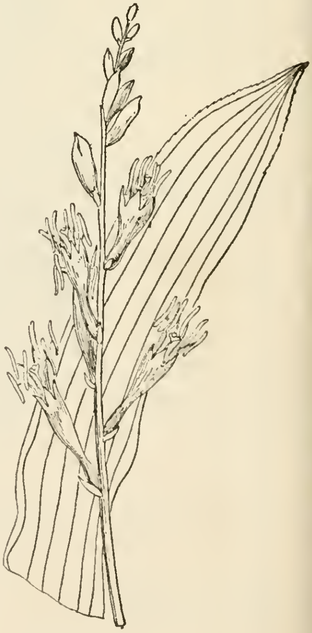

Fig. 166. False Aloe (*Agave virginica*). A plant of the Southern United States.

berry roundish, red and few-seeded. The species is native to Europe, Asia, and the Alleghanies, and is widely cultivated as an ornamental plant.

Poisonous properties. The plant contains two glucosides; one, *convallamarin* $C_{23}H_{44}O_{12}$, an extremely poisonous crystalline compound with a bitter sweet taste, with a physiological action on the heart like digitalin, a substance found in the common foxglove, and *convallarin* $C_{34}H_{31}O_{11}$, which is crystalline, has a sharp taste and is purgative in its action. Chesnut says: "The amegative and purgative actions of the lily of the valley are quite marked." The action of the heart is infrequent and irregular, and finally death occurs from paralysis.

Trillium L. Birthwort

Herbs, with naked stem from a short, horizontal root stock, netted veined, simply whorled leaves, in 1 or 2 whorls; colored flowers, 3 green persistent sepals; 3 colored petals which wither with fruit; stamens 6, hypogynous; linear, adnate anthers on short filaments; sessile stigmas 3; ovary 3-celled; fruit a berry.

The principal species of the United States are: the wake-robin (*T. nivale*), which flowers very early in the spring, is from 2-4 inches high and is common northward and eastward; the sessile-flowered wake-robin (*T. sessile*) which bears sessile dull purple flowers with narrow sepals and petals, and leaves that are often blotched and occurs from eastern Iowa southward; prairie wake-robin (*T. recurvatum*) of the west, which has dull purple petals but differs from the preceding in having narrow leaves; large white-flowered wake-robin (*T. grandiflorum*) which bears a large white flower raised on a peduncle later recurving from the erect, the flowers becoming purplish, and rounded, ovate, sessile leaves; and birthwort (*T. erectum*) much like *T. grandiflorum* except that the flowers are not so large and are unpleasantly scented. Both of the two last named are found in the eastern and central states.

Poisonous properties. Trilliums have long been considered poisonous. All species are emetic. Lindley states that the roots have a violent emetic action. The fruit should be regarded with suspicion.

HAEMODORACEAE. Bloodwort Family

Prerennial herbs with fiborous roots; leaves, narrow, lanceolate and somewhat erect; small perfect flowers which are woolly or scurfy on the outside; flowers in panicles; perianth 6-parted or 6-lobed adnate to the ovary;stamens 3, opposite the 3 inner segments of the perianth; stigmas 3; fruit a 3-valved capsule, seeds few or numerous. A small family of 9 genera and 35 species mostly native to Africa, Australia and tropic America.

Lachnanthes. L. Red-Root

A stout herb with short rootstock; red, fibrous, perennial root; leaves, equitant and sword shaped, crossed at the base and scattered on the stem; flowers, numerous, borne in a woolly, cymose panicle; perianth, 6-parted, the outside segments smaller than the inner; stamens, 3, opposite the 3 inner divisions; pistil with 3-celled ovary few ovules in each cavity; seeds few, flattened nearly orbicular, fixed by the middle. A species of a single genus native to southeastern North America and western India. (*Gyrotheca*).

Lachnanthes tinctoria, (Walt.) Ellis.

A stout, tall herb with numerous yellow flowers, 6-parted perianth and few seeds.

Distribution. In salty swamps near the coast in southeastern Massachusetts, Rhode Island and New Jersey to Florida. This plant is commonly called the pink-root of the Atlantic coast.

Poisonous properties. Prof. Chesnut says that throughout the South, white hogs are supposed to be particlaraly subject to the poison contained in this plant. Dr. Halsted says "Throughout the southern states, this plant abounds and the preponderance of black over white-skinned hogs is claimed to be due to this paint-root. White hogs with free access to the plant are soon killed off, while black ones are not.

This is not the only case of the color of animals seeming to have an influence upon their distribution. Thus, white horses in Prussia, it is claimed, are injured by eating milkweed, while dark horses are not. In Sicily, there are black sheep, only, as white ones are killed off by a species of St. John's wort (*Hypericum*)." While the claim of the immunity of black pigs from the effects of paint-root seems to be a common belief, further investigation should be made before this should be assured definitely as a fact.

Family *Amaryllidaceae.* Amaryllis Family

Mostly perennial herbs with bulbs, rootstocks or corms; scapose flowers regular or nearly so; perianth 6-parted or 6-lobed, the lobes or segments distinct, united below into a tube, adnate to the ovary; stamens 6; style single; capsules several, many seeded. About 800 species, chiefly native of tropical or warm regions, a few in temperate regions. Some well known representatives are daffodil, (*Narcissus Pseudo-Narcissus*); Polyanthus, (*N. Tazetta*); poet's Narcissus, (*N. poeticus*) producing intense gastro-enteritis; Jonquil, (*N. Jonquilla*); snowdrop, (*Galanthus nivalis*); amaryllis, (*Amaryllis Belladonna*); tuberrose, (*Polianthes tuberosa*), the latter widely cultivated; the American aloe or agave, the most common species in cultivation being the century plant (*Agave americana*) native to Mexico and Central America, the Mexican drink, pulque, being made from the sweet liquid obtained from this plant at the time of flowering. Several species are used for the manufacture of fibre, the best known being the sisal, (*Agave rigida*). The mauritius hemp, (*Furcraea gigantea*), is native to Mexico and has been introduced into Zanzibar. Many members of the family have acrid properties and some of them are poisonous. *Buphane disticha* is used by the Hottentots to poison their arrows. Poet's narcissus contains *pseudo-narcissin; Amaryllis Belladonna* contains *belladonin*; and *Sprekelia formossissima* contains *amaryllin,* a belladonna-like alkaloid. The *Lycoris* species contain *lycorin,* an alkaloid with the formula $C_{32}H_{32}N_2O_8$, and a second alkaloid *kisanin,* $C_{34}H_{36}N_2O_2$. *Agave heteracantha* contains *agavesaponin.* Dr. MacDougal states that the sharp pointed leaves of *Agave Schottii* often penetrate leggins and leather shoes inflicting painful injuries.

Zephyranthes. Herb

Smooth herb with coated bulbs; narrow leaves; flowers scapose, large erect, pink, white or purple;perianth funnel-form from a tubular base; the 6 divided petals are united below into a tube subtended by an entire or 2-cleft

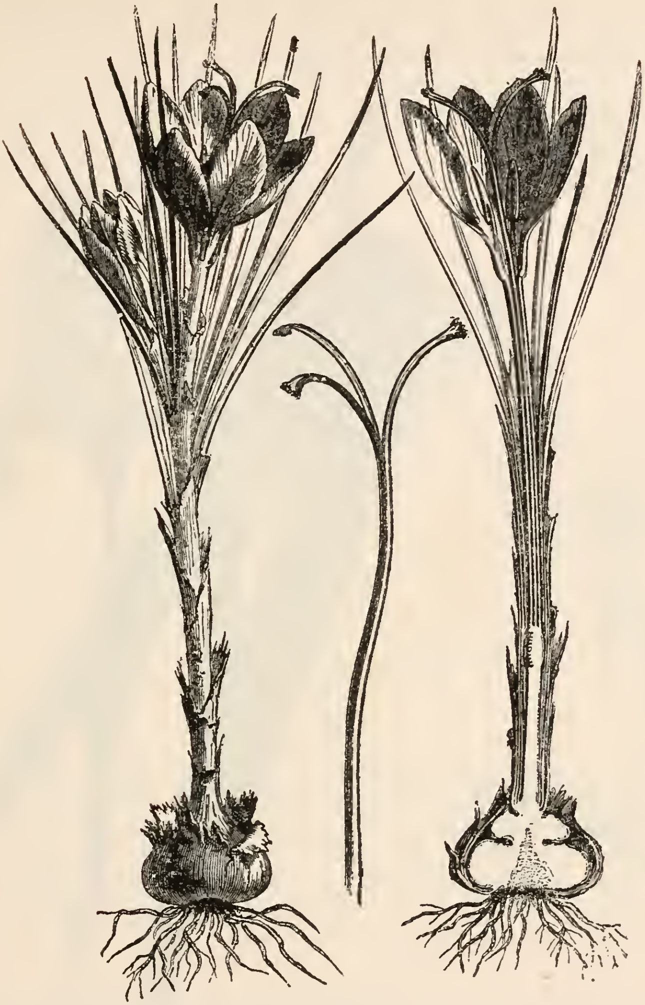

Fig. 167. Saffron (*Crocus sativus*). The flowers furnish the saffron of commerce. (Faguet).

bract; ovary 3-celled; style long, filiform, 2-cleft at the summit; ovules numerous; capsules membranceous; seeds flattened, blackish; small genus of 30 species, native to America.

Zephyranthes Atamasco (L.) Herb. Atamasco Lily

Leaves bright green and shiny from an ovoid bulb; scapes erect; bracts 2-cleft; perianth white, pinkish or light purple; segments shorter than the two stamens.

Distribution. In moist places from eastern Virginia to Florida and Alabama.

Poisonous properties. Prof. Chesnut, in speaking of this plant, says that the Atamasco of the southeastern United States is supposed by some persons to cause the disease in horses known as "staggers."

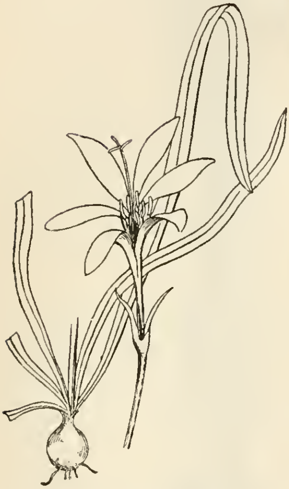

Fig. 168. Atamasco Lily (*Zephyranthes atamasco*). A plant of the southeastern United States, supposed to cause "staggers' in horses.

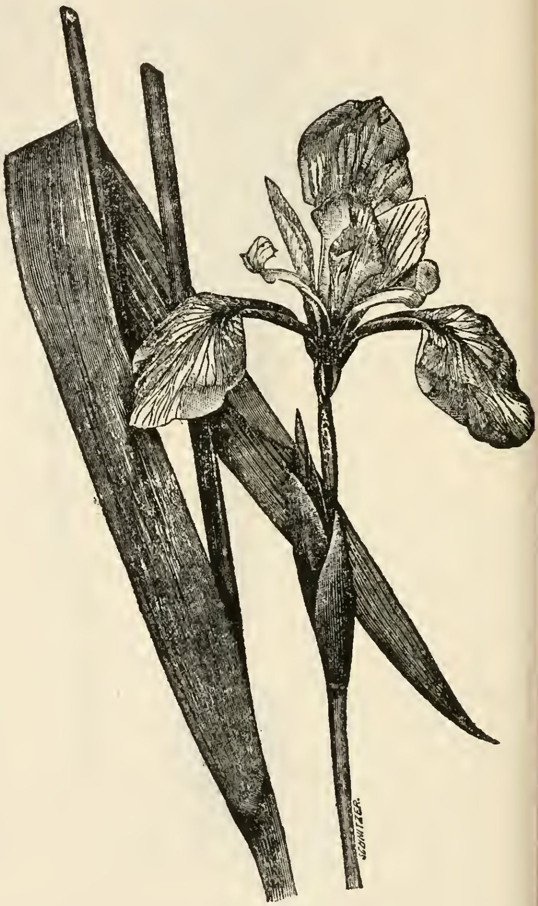

Fig. 169. Blue Flag (*Iris versicolor*). The rootstock is poisonous. The plant grows in low grounds. (After Johnson.)

Family IRIDACEAE. Iris Family

Perennial herbs, frequently with bulbs, corms or tubers; leaves equitant, erect, 2-ranked; perianth of 6 segments or 6-lobed, its tube adnate to the ovary; stamens 3, adnate to the ovary; anthers facing outward; ovary inferior, mostly 3-celled; style 1 or 3-cleft, stigmas 3, opposite the three stamens; ovules generally numerous in each cell; embryo small; endosperm, fleshy, or horny.

About 1000 species, of wide distribution. Common native plants of the family are the blue flag (*Iris versicolor*), growing in low grounds of the North;

the Carolina blue flag (*I. carolina*) of the South, blue eyed grass (*Sisyrinchium angustifolium*). Many species of the exotic blue flags, Iris like the dwarf garden iris (*I. pumila*) and the common flower-de-luce (*I. germanica*), the common crocus or saffron (*Crocus vernus*) used for coloring, freesia (*Freesia refracta*), tritonia and gladiolus are cultivated for ornamental purposes. The orris root (*Iris florentina, I. pallida* and *I. germanica*) is an article of commerce used for perfume and tooth powders. It contains myristic acid. A substitute for saffron is obtained from the flowers of the South American saffron (*Crocosmia aurea*).

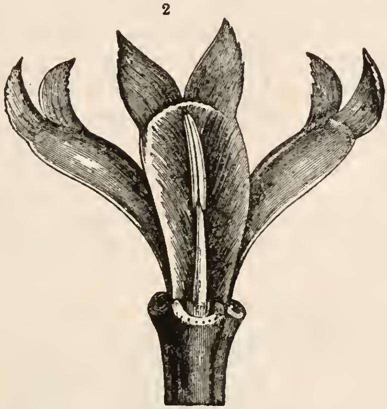

Fig. 169a. The petaloid bilobed stigma and stamen of Iris. (Kerner).

Iris (Tourn) L.

Herbs with creeping or horizontal root stocks, and erect stems with equitant leaves; flowers large, regular, panicled; perianth of 6 segments united below into a tube, the outer dilated, spreading or reflexed; the 3 inner, smaller; stamens inserted at the base of the outer perianth; ovary 3-celled; fruit a capsule; seeds numerous. About 100 species in the North Temperate regions. The *Iris florentina* contains the glucoside *irigenin* $C_{18}H_{16}O_8$. This is derived from *irisin.*

Iris versicolor, L.

Root stock fleshy; stem roundish; leaves erect, leaves shorter than the stem; flowers bluish, perianth deeply 6-parted, the 3 outer divisions reflexed, the 3 inner smaller, erect; stamens distinct, covered by the petaloid stigmas.

Distribution. In marshes, thickets, and wet meadows from Newfoundland to Manitoba, south to Florida and Arkansas.

Poisonous properties and uses. The root contains the substance *irisin,* or *iridin.* The acrid resinous substance, *irisin,* acts powerfully upon the gastro-intestinal tract, liver and pancreas, causing a burning sensation and congestion. That the root is poisonous may be seen from the following statement made by Dr. Rusby:

> Another rhizome whose acrid taste is likely to prevent ingestion in poisonous quantity, is that of the common *Iris versicolor,* L. Still, because this is commonly known as the blue flag, there is some danger that it might be eaten in mistake for calamus, which is commonly known as sweet-flag. If so, it would prove seriously, if not fatally poisonous

as its well-known emetic-cathartic properties, even when toned by drying and keeping, are powerful, and in a fresh state would be decidedly violent.

Dr. Johnson says:

> Iris, in full doses, is an active emeto-cathartic, operating with violence, and producing considerable prostration. Its effects upon the liver appear to be analogous to those of podophyllum. In sick headache dependent upon indigestion, small doses, frequently repeated, often act most happily. It has been largely used by eclectic practitioners, and is highly esteemed by them as a hydragogue cathartic, an alterative, sialagogue, vermifuge, and diuretic.

One case of poisoning has been recorded in this state. Other species of *Iris* of which we have quite a number in the U. S. must be looked upon with suspicion. Mention may be made here of the *Iris missouriensis* and *I. carolina.* The root stocks of our cultivated species like *I. pumali* and *I. sibirica* must be looked upon with suspicion. The South African *Homeria collina* naturalized in Australia, according to Maiden, is poisonous to cattle browsing on the plant.

SCITAMINEAE

Large herbs with endogenous stems and monocotyledonous seeds; flowers very irregular; ovary inferior, composed of several united carpels; seeds

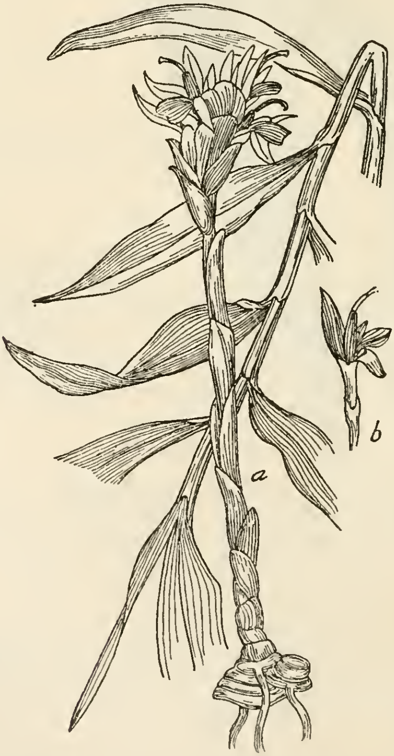

Fig. 170. Ginger (*Zingiber officinale*). *a.* Entire plant. *b.* flower. (Charlotte M. King, after Strasburger, Schenck, Noll and Schimper.)

with endosperm. This order contains the important family *Musaceae* in which is found the banana (*Musa sapientum*), well known as an article of commerce. It is extensively cultivated in the tropics and one of the most important food plants in all warm countries. The fruit is eaten fresh when ripe; a kind of flour is also made from it. *M. textilis* is an important fiber plant being the source of Manilla hemp, large quantities of which are imported from the Philippines. The ravenala or traveler's palm also belongs to this family. It has an oily, edible, arillus which is bright blue. The family *Cannaceae* contains the Indian shot (*Canna indica*), frequently cultivated for ornamental purposes in this country; in tropical regions, however, a starch is made from the rhizome of this species and from *C. edulis*. *C. flaccida* is a native of the southern United States and has a pretty blue flower. The family *Marantaceae* contains the West Indian arrowroot (*Maranta arundiacea*). The family *Zingiberaceae* includes ginger (*Zingiber officinale*) which contains gingerol and is used as a condiment and stimulant. The ginger of commerce is derived from the fleshy rootstock, the plants grown in Jamaica being considered most valuable. These are cultivated in regions having an altitude of 2000 feet. Malabar cardamon (*Elettaria Cardamomum*) round cardamon (*Alpinia striata*), bastard cardamon (*Amomum xanthioides*), Bengal cardamon (*A. subulatum*) and Java cardamon (*A. maximum*) also belong to this order. The *Kaempferia rotunda* of India, is a bulbous or tuberous rooted biennial which according to Major Kirkitar, causes profuse salivation and vomiting when administered internally. The rhizome of *K. Galanga* furnishes a perfume.

Arrowroot comes from *Curcuma leucorhiza*, and turmeric from *Curcuma longa*. The tuber of the latter, when powdered, is used as a yellow dye-

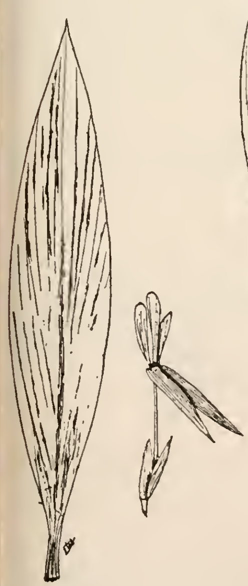

Fig. 171. Canna (*Canna flaccida*). A native American Canna.

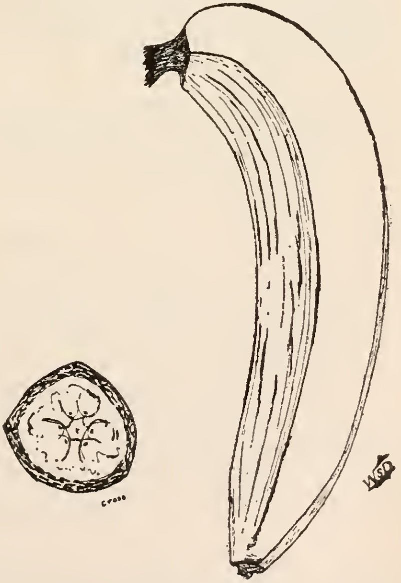

Fig. 172. Banana Fruit (*Musa sapientum*). A well known tropical fruit. W. S. Dudgeon.

stuff, in making turmeric paper, as a condiment, especially in curry powder, and as an aromatic stimulant. The zedoary, (*C. Zedoraia*), is used in Himalayan India, where it is native, in place of turmeric. Galangal is the root of *Alpinia officinarum* which grows on the Chinese coast. Another species, *A. Galanga* is used on the island of Java.

MICROSPERMAE

Herbs with endogenous stems, flowers very irregular or in a few cases regular, generally complete and perfect, and parts in 3's or 6's; ovary inferior compound; seeds small, numerous, without endosperm.

Family ORCHIDACEAE. Orchid Family

Perennial herbs with corms, bulbs or tuberous roots; perfect and irregular flowers; perianth of 6 divisions in 2 sets, the 3 outer similar in texture to the 3 inner petals, one of the 3 inner, different in form and is called the lip; in front of the lip is a column composed of a single stamen, or in *Cypripedium* of two stamens, and a rudiment of the third; pollen in 2 or 8 pear shaped sacs called pollinia which are united by little threads. Stamens variously united with the thick, fleshy style into a column; ovary 1-celled with many ovules on a three parietal placentae; capsule 1-celled, 3-valved, seeds numerous. A large order of about 5000 species of wide distribution, most abundant in the tropics. Many of the plants like the *Cypripedium, Angrecum* and the *Catasètum* are cultivated for ornamental purposes.

The salep of commerce is obtained from the *Orchis masculata.* The flavoring material, vanilla, is obtained from *Vanilla planifolia,* native to Mexico and widely distributed by cultivation; this plant contains from 1½ to 3 percent of *vanillin* $C_8H_8O_3$. Other species of the genus *Vanilla* also furnish vanilla but in smaller quantities; these are *V. Pompona, V. guianensis,* and *V. palmarum. Vanillin* is also made from *coniferin* and *eugenol,* and occurs in other orchids as *Spiranthes* and such plants as *Spiraea Ulmaria* and *Lupinus albus.* It is used for medicine.

Orchids contain some alkaloids; for example, *Phalanopsis amabilis* contains a tonic alkaloid, according to Boorsnis, which is closely related to *coniferin,* $C_{16}H_{22}O_8$.

Cypripedium L.

Tufted roots; perennial, glandular, pubescent herbs; leaves large, many nerved; flowers solitary or few; sepals shiny, spreading, 3 distinct or 2 of them united into one, under the lip; petals spreading, resembling the sepals; lip of large inflated sac, column declined with a fertile stamen on each side; a sterile petaloid stamen above, which covers the summit of the style; pollen granular, stigma broad, obscurely 3-lobed, moist and roughish. About 40 species, mostly tropical.

Crypridium parviflorum, Salisb var. pubescens (Willd) Knight. Yellow Lady Slipper

Perennial, with leafy stem, 2 feet high, pubescent; leaves oval, or elliptical, acute; sepals ovate, lanceolate, usually larger than the lip, yellowish or greenish; petals narrower, usually twisted; lip flattened laterally, pale yellow with purple lines.

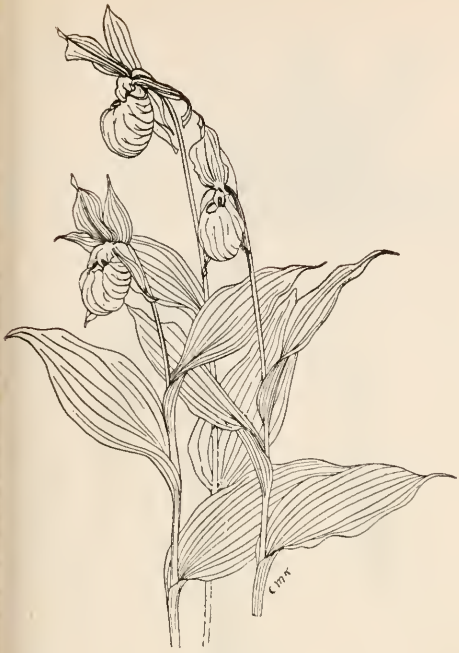

Fig. 173.

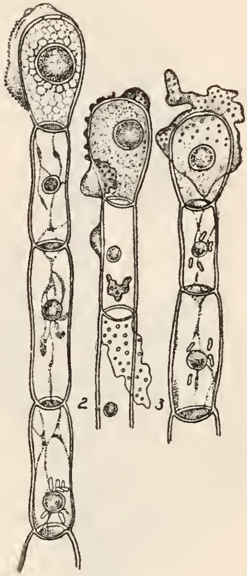

Fig. 174.

Fig. 173. Smaller Yellow Lady Slipper (*Cypripedium parviflorum, var pubescens*). A beautiful flower of early summer, seen in the woods of eastern Iowa. C. M. King.

Fig. 174. Glands of several species of Moccasin flower, which are said to contain the toxic substances. 1. Hair gland of *Cypripedium pubescens*. 2. Hair gland of *Cypripedium hirsutum* in water. 3. Hair gland of *Cypripedium Calceolus* in water. (Charlotte M. King, after Nestler.)

Distribution. In woods and thickets, chiefly east of central Iowa, and Minnesota to Nova Scotia; occasionally in Colorado, Nebraska and Alabama.

Cypripedium candidum Muhl. Small White Lady Slipper

A slightly pubescent perennial; leaves lance-oblong, acute; petals and sepals greenish, purple spotted; sepals ovate-lanceolate, lips white striped with purple inside, flattened laterally, convex above.

Distribution. In bogs and meadows from New York to Minnesota, Iowa, Nebraska and Missouri.

Cypripedium hirsutum Mill. Showy Lady Slipper

A rather stout, downy perennial 2 feet or more high; leaves ovate pointed; sepals round ovate, or orbicular, longer than the petals, which are obovate; lip inflated, white, pink purple stripes.

Distribution. In woods and swamps from Nova Scotia, Ontario and Georgia west to Minnesota and Iowa.

Poisonous Properties. Dr. Babcock, many years ago, found that the several species of Lady's Slipper produced dermatitis. Years ago the writer heard of a case of poisoning where a young man carried a large bunch of

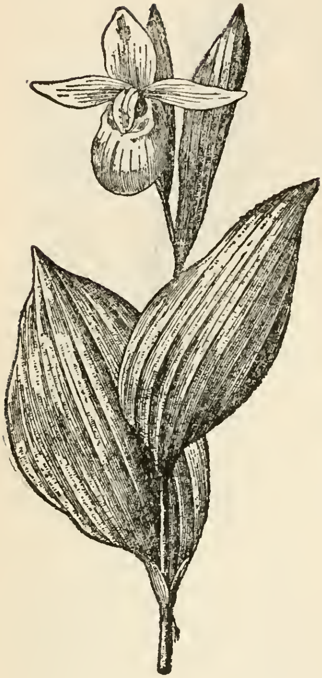

Fig. 175. Showy Lady Slipper (*Cypripedium hirsutum*). A plant thought to cause dermatitis. C. M. King.

Fig. 176. Flower of another orchid (*Habenaria*).

Showy Lady Slipper and became poisoned very much as if it were by poison Ivy. Prof. Chesnut in referring to the poisoning from these plants says:

> The poisonous character of these plants was not suspected prior to 1875, when Prof. H. H. Babcock, of Chicago, who had annually been suffering, supposedly from recurrent attacks of ivy (Rhus) poisoning, discovered that the affection was most probably caused not by the ivy, but by the two species of Lady's Slipper named above (*C. parviflorum*, var. *pubescens* and *C. hirsutum*) instances were afterward reported, but the facts were not positively ascertained until 1894, when an investigation was made by Prof. D. T. MacDougal of the University of Minnesota. It was discovered that these plants are provided with glandular hairs which cover the surface of the stem and leaves and contain a poisonous oil which is especially abundant at the fruiting season. Its action on the skin is very similar to that of toxicodendrol, the active constituent of poison Ivy (*Rhus Toxicodendron*), but its exact chemical nature could not be ascertained on account of the small quantity obtainable. Experiments with the stem and leaves upon individuals showed that over half of them were affected by the first two species, and that the last was also poisonous, but in a minor degree. No accidental cases have been recorded against it. No specific antidote has been suggested.

Dr. MacDougal* made a personal experiment with a mature specimen of *C. hirsutum* on which there were newly formed seed pods. This plant was broken off near the base of the stem and the leaves brushed lightly over the arm.

> A slight tingling sensation was felt at the time, and, fourteen hours later, the arm was greatly swollen from the shoulder to the finger tips. The portion covered by the plant — covering an area of 50 sq. cm. — was violently inflamed and covered with macules, accompanied by the usual symptoms of dermatitis and constitutional disturbances. By treatment of the most approved kind, the arm was reduced to its normal size in ten days, but the effects were perceptible a month later.

Nestler discovered that the secretion contained in these hairs was a fatty acid readily soluble in alcohol and benzol and producing a mildly acid reaction. He also states that his results with *C. pubescens* were negative but that with *C. spectabile* (*C. hirsutum* Mill.) he secured positive results, producing a dermatitis, the action, however, not being so pronounced as that reported by MacDougal. He also found that, as stated above, the maximum poisonous effect was during the formation of seed capsules and that the poison was in the hairs of the plant as is the case in the Primrose. Nestler did not succeed in producing dermatitis with *C. parviflorum, C. acaule, C. macranthum, C. montanum,* or *Calceolus.* As some of these species produce an abundance of raphides in the stem, it is evident that dermatitis is not caused by these crystals, but rather by a substance found in the stem. Dr.MacDougal suggests that the raphides may serve the plant as a protection from animals.

Nestler also asserts that the *Cypripedium* may contain an additional substance *myelin* which Senf has found in Ginkgo seed, and Nestler[1] himself observed in the fruit of *Capsicum annuum.* It is not a cardol.

From the root of *Cypripedium* a substance is obtained which is sometimes administered to children as a substitute for opium. It contains a bitter glucosidal principle.

Class, DICOTYLEDONEAE

Stem usually oxogenous with pith, wood and bark (endogenous in a few plants); the woods traversed by medullary rays; leaves usually pinnately or palmately netted-veined; embryo of the seed with 2 cotyledons or occasionally 1; parts of the flower usually in 5's, rarely in 3's or 6's.

Archichlamydeae

Petals separate and distinct from each other or wanting. Includes many plants classed as *Apetalae* and *Polypetalae.* In some orders, as *Leguminosae,* the lower petals are more or less united and joined at the base.

VERTICILLATAE

Contains a single family *Casuarinaceae* of 20 species, mostly Australian, with monoecious flowers. The *Casuarina equisetifolia* of the tropical Old World furnishes a hard wood known as iron wood and in Egypt the trees are used as a shelter belt for bananas.

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* Minn. Bot. Studies. 1894:32-36.

[1] Das Sekret der Drusenhaare der gattung Cypripedium mit besonderer Berücksichtgung seiner hautreizenden Wirkung. Nestler. Ber. der Dent. Bot. Gesell 25:554-567.

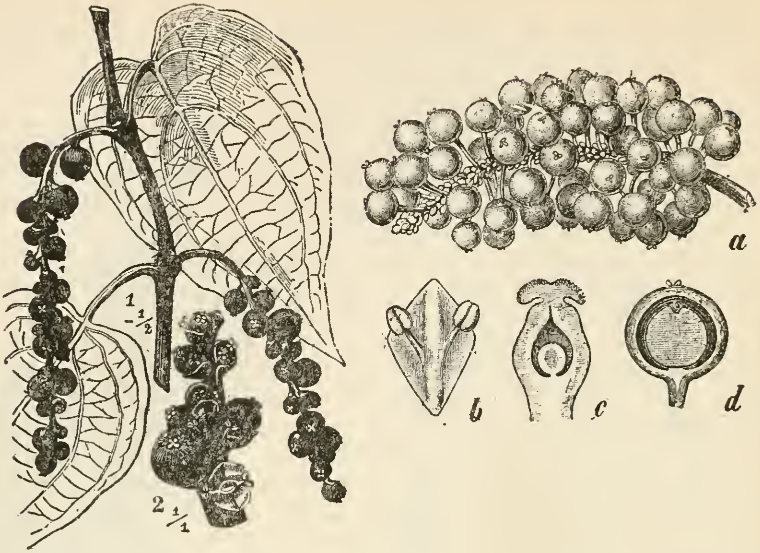

Fig. 177. Black Pepper Plant (*Piper-nigrum*). 1. Part of shoot with young fruit. 2. Tip of fruit spike. (After Wossidlo.)

PIPERALES

Herbs with exogenous stem, with neither petals nor sepals; flowers in spikes, bracteolate. Largely tropical and includes the family *Saururaceae* or Lizard's tail; the peppers, *Piperaceae*, including black pepper (*Piper nigrum*) a well known condiment of the tropics containing the alkaloid *piperin* $C_{17}H_{10}NO_3$ and a volatile oil $C_{10}H_{16}$, cubebs (*P. Cubeba*) containing *cubebin* $C_{10}H_{10}O_3$ and the oil of cubebs, kava-kava (*P. methysticum*) native to the Pacific Islands, containing *methysticin* $C_{15}H_{14}O_5$, which is used to make stimulating drinks, *P. longum* of India, *P. chaba* of India and the Philippines, the Betel Pepper (*P. Betle*) of the Malay Islands, the berries of which are chewed with the Betel Nut, and the Matico, or the Soldier's Herb (*P. angustifolium*) of South America, the hairy leaves of which are used as a styptic. The South American *Peperomias* are well known greenhouse plants. Other species of peppers are used in medicine. The so-called "caisimon" (*P. peltutum*), according to Mr. Combs, is a powerful diuretic. "Matico de Peru" (*P. angustifolium*) is an acrid, bitter plant containing a green volatile oil.

SALICALES

Trees or shrubs with simple flowers, imperfect catkins; perianth wanting; fruit a many-seeded capsule; seeds with a tuft of hair at one end. This series contains only one family the *Salicaceae.*

Salicaceae. Willow Family

Dioecious trees or shrubs, alternate stipulate leaves, the stipules often minute and soon falling; staminate and pistillate flowers borne in catkins, one to each bract, without calyx or corolla; staminate flowers with 1-numerous

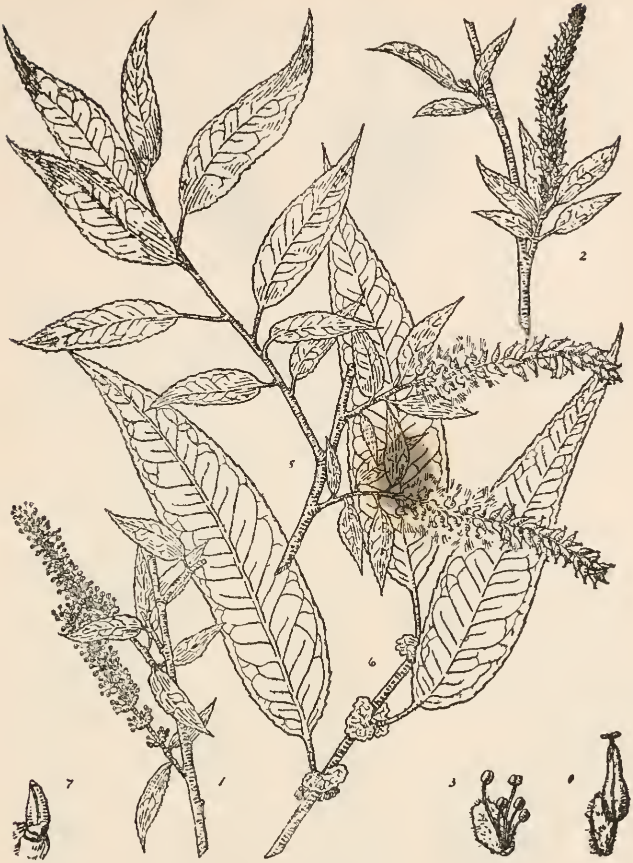

Fig. 178. Peach-leaved Willow (*Salix amygdaloides*). 1. Flowering branch of staminate tree. 2. Same of pistillate tree. 3. Staminate flower, with scale, enlarged. 4. Pistillate flower enlarged. 5. Fruiting branch. 6. Summer branch. 7. Bud and leaf scar. 1, 2, 5, 6, one-half natural size. M. M. Cheney.

stamens, subtended by a cup-shaped disk; pistillate flowers with a 1-celled ovary, stigmas 2-4, simple or 2-4-cleft; fruit a 1-celled and 2-4 valved pod bearing numerous seeds provided with long silky hairs. There are only two genera and about 200 species, found in temperate and Arctic regions. The bark of some species of the family is used in medicine because of its astringent properties. The willow contains the glucoside *salicin* $C_{13}H_{18}O_9$. Poplar contains *populin* $C_{20}H_{22}O_8$. The Balm of Gilead (*Populus candicans*) may cause blistering, and the European *P. balsamifera* causes colic.

Myricaceae. Sweet Gale Family

Monoecious or dioecious shrubs with alternate, coriaceous, aromatic leaves; flowers in short scaly catkins; staminate flowers with 2-16 but usually 4-8 stamens; ovary with 2-8 scales and 2 linear stigmas; fruit a small 1-celled

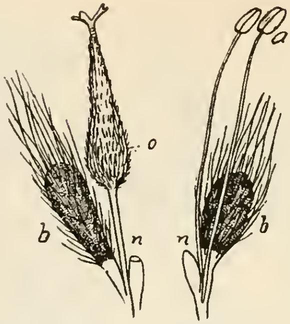

Fig. 179. Pistillate and staminate flower of willow. *n.* nectar gland. *b.* scale.

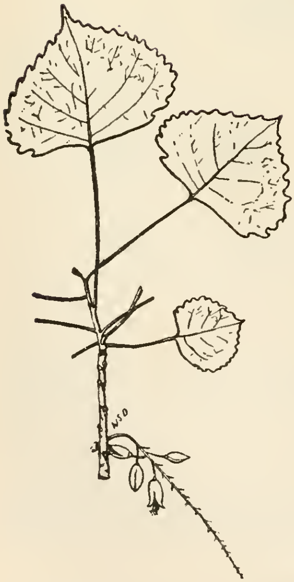

Fig. 180. Leaves of Cottonwood (*Populus deltoides*). A well known native tree growing on the borders of streams throughout the U. S. east of the Rockies. (W. S. Dudgeon.)

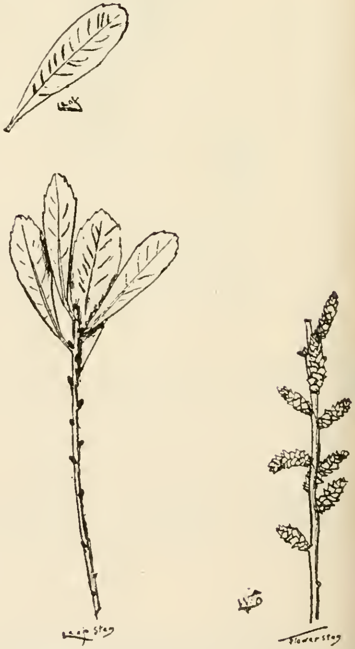

Fig. 180a. Sweet Gale (*Nmrica*). Common in the east.

drupe, the outer part frequently covered with wax. About 35 species of wide distribution. The sweet fern (*Myrica asplenifolia*) is sometimes weedy in sandy fields in the North; it contains an oil of strong, spicy, cinnamon-like odor; bayberry wax is derived from *M. cerifera,* common along the Atlantic coast and the Gulf of Mexico. The bark of *Myrica Nagi* contains *myricetin* $C_{15}H_{10}O_8$. The leaves of *M. acris* are used in the preparation of bay rum.

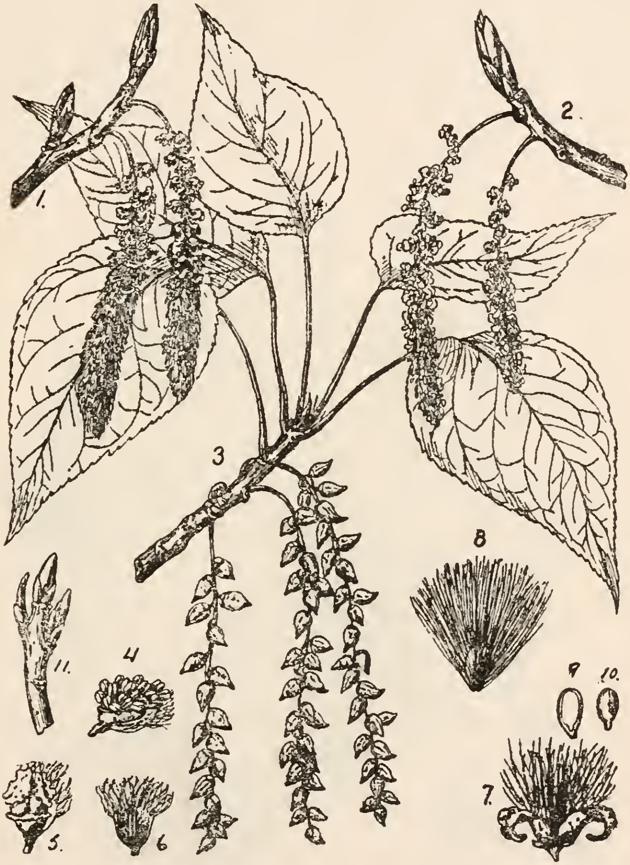

Fig. 181. Balm of Gilead (*Populus candicans*). 1. Flowering branch of staminate tree. 2. Same of pistillate tree. 3. Fruiting branch. 4. Scale of staminate catkin, enlarged. 5. Scale of pistillate catkin, enlarged. 6. Scale without flower displayed, enlarged. 7. Mature fruit. 8. Seed, enlarged. 9. Longitudinal section of seed, enlarged. 10. Embryo, enlarged. 11. Winter branch, showing buds. 1, 2, 3, 11, one-half natural size. M. M. Cheney.

BALANOPSIDALES

Contain a single family, the *Balanopsidaceae* of New Caledonia, which in turn contains a single genus *Balanops* of 7 species.

LEITNERIALES

Shrubs or trees with entire, petioled, simple leaves; flowers in catkins; staminate flowers subtended by what appears to be a perianth; sepals 3-4; ovary 1-celled; style slender; endosperm thin. Only one family, the *Leitneriaceae,* which consists of a single genus *Leitneria,* with perhaps 2 species. *L. floridana* occurs in swamps in southern Missouri to Texas and Florida and produces a wood lighter than cork, probably the lightest wood known.

JUGLANDALES

Trees with alternate, pinnately-compound leaves; flowers monoecious, bracteolate; the staminate in long drooping catkins; pistillate solitary or several together; staminate flowers of 3-many stamens with or without a perianth; peri-

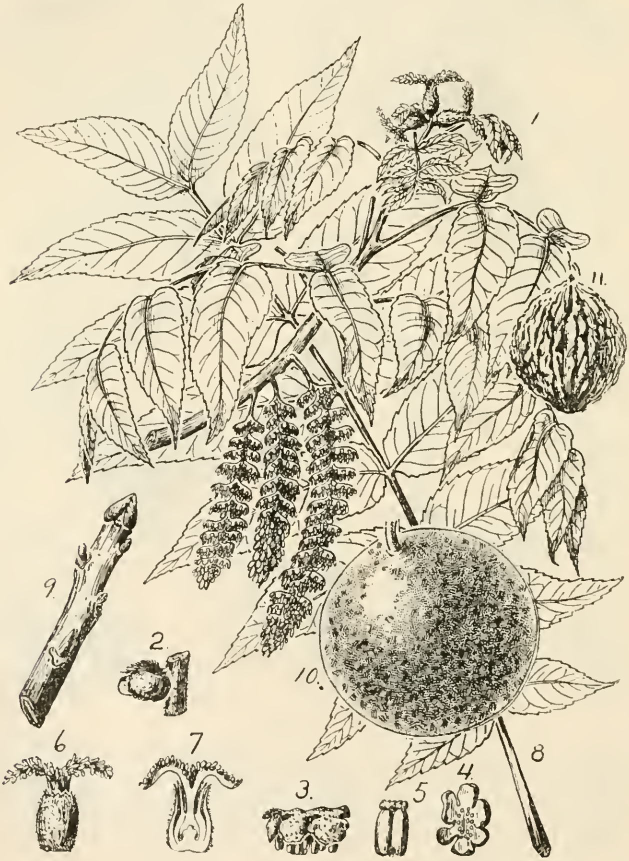

Fig. 182. Black Walnut (*Juglans nigra*). 1. Flowering branch. 2. Staminate flower before anthesis, enlarged. 3. Staminate flower, enlarged. 4. Perianth of staminate flower, enlarged. 5. Stamen, enlarged. 6. Pistillate flower, natural size. 7. Longitudinal section of pistillate flower, natural size. 8. Leaf, reduced. 9. Winter branchlet. 10. Mature fruit. 11. Walnut with husk removed. 1, 9, 10, 11, one-half natural size. M. M. Cheney.

anth adnate to the ovary; anthers erect, 2-celled; pistillate flowers usually 2-bracteolate, calyx 4-lobed or with petals; ovary inferior, 1-celled or incompletely 2-4 celled; ovule solitary, erect; styles 2; fruit generally a drupe, dehiscent or indehiscent; the involucre regarded by some as the calyx, encloses the nut, which is incompletely 2-4 celled; endosperm none, cotyledons corrugated, oily. One family *Juglandaceae*. The English Walnut (*Juglans regia*) from the Mediterranean region to the Himalayas is extensively cultivated in California, Spain, France, Italy, and other warm temperate countries; butternut (*Juglans cinerea*), from New Brunswick to North Dakota and Nebraska, produces a valuable wood which is, however, inferior to the black walnut (*Juglans nigra*), distributed from Massachusetts to Minnesota, Kansas and Texas, but the timber is becoming scarce. There is a popular impression that the black walnut is poisonous to vegetation growing under the trees. California Walnut is *J. californica*. The Japanese walnut (*J. Sieboldiana*) produces a large, thick-shelled nut. The bark of *Juglans* contains *juglandic acid* $C_{10}H_6O_8$. The *Pterocarya caucasica* is a native to the Trans-Caucasus.

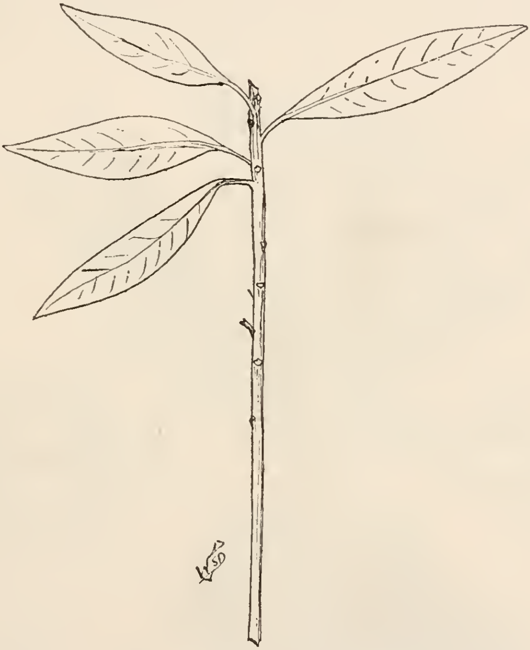

Fig. 183. Cork Wood (*Leitneria floridana*). The wood of this plant is extremely light. It grows in swamps in Southern Missouri and Florida. (W. S. Dudgeon.)

The genus *Carya* is native to North America and yields valuable timber and nuts. The nut of the pecan (*Carya illinoensis*) is an important article of commerce in Texas and other southern states. The wood is also used. The shellbark hickory (*Carya ovata*) and the Missouri hickory (*C. laciniata*) supply valuable woods which are used in the manufacture of ax handles and for parts of wagons. The nut of the latter is large but like the preceeding one and the

C. tomontosa has a hard shell. The bitternut (*C. cordiformis*) and pignut (*C. glabra* have soft shells. The bark of hickories is used to flavor and color glucose to imitate maple sugar.

FAGALES

Monoecious or rarely dioecious trees or shrubs, with simple alternate leaves; stipules deciduous; calyx usually present; corolla usually wanting; staminate flowers in catkins; stamens 4-20; pistillate flowers solitary, clustered in scaly catkins; ovary more or less 2-7-celled with 1-2 pendulous, straight ovules, all the ovules but one disappearing in fruit; involucre becoming a burr or cup; embryo large; endosperm none. This is an important order, including the chesnut, oak, birches and alders. The bark of a few species of *Quercus*, because of its astringent qualities is used in medicine. The European filbert (*Corylus Avellana*)

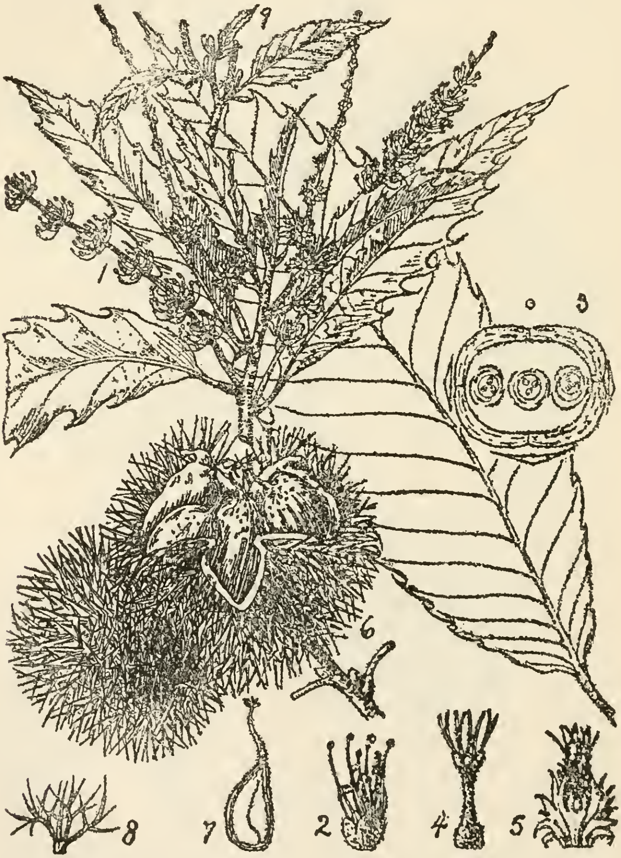

Fig. 183. American Chestnut (*Castanea americana*). 1. Flowering branch. 2. Staminate flower, enlarged. 3. Diagram of pistillate flower, cluster. 4. Pistillate flower, enlarged. 5. Longitudinal section of involucre of pistillate flowers. 6. Portion of fruiting branch. 7. Longitudinal section of fruit. 8. Involucral spine. 9. End of young branchlet. 1, 6, 7, one-half natural size. M. M. Cheney.

and our hazel nut (*C. americana*) are articles of commerce. Both the American beech (*Fagus ferruginea*), and the European (*F. sylvatica*), are prized for their nuts, which contain a valuable oil. The chestnuts are well known in commerce. The American chestnut (*Castanea dentata*) is common in the United States. The European species (*C. sativa*), has long been cultivated in North America; the Japanese (*C. japonica*) is also cultivated. In southern Europe, starch and flour are made from the nuts of the Spanish chestnut (*C. sativa*). The wood of many species of oak is used for interior finishing and furniture, among these are white oak (*Quercus alba*), red oak (*Q. rubra*), pin oak (*Q. palustris*), English oak (*Q. Robur*) and the live oak (*Q. virginiana*) of the south. The bark of several species like the scarlet oak (*Q. coccinea*), English oak, and chestnut oak (*C. Muhlenbergii*) is used for tanning. Cork is obtained from the bark of *Q. Pseudo-suber.* The galls of *Q. lusitanica* are used for dyeing purposes. They are known as the Aleppo galls and contain from 60-70 per cent of tannic acid. The bark of the White Oak is used in medicine and is recognized as medicinal in the United States Pharmacopoeia. The main constituent of oak bark is tannin which is used like other astringents.

The acorns of the Belotes, the evergreen oak of Europe (*Q. Ilex*) are used for food. The oaks are well represented in eastern North America, several handsome species also occurring on the Pacific coast.

Formerly, and perhaps even now, in some regions the acorns of the White Oak and the Bur Oak were dried, roasted, ground, and used very much as the coffee berry.

In Europe, various species of oaks cause sickness and death in hogs and cattle. Dr. Chesnut suggests that this might possibly be caused by the tannin or bitter principle contained therein.

In sections of the country, where oaks are common, hogs are allowed to run in the forests, the farmers considering that the acorns are fattening. In some parts of the south, it is believed that the mast of oaks makes excellent feed for hogs but is poisonous to cows, a small amount merely decreasing the flow of milk while a greater quantity causes death. It is also claimed that the "sweet mast," that of the white and bur oaks, is less poisonous than the "bitter mast" of mast of black, pin, red and cow oaks. Mr. E. B. Watson made some inquiries upon this subject for me, among southern farmers and obtained evidence of four men, which differed slightly in detail but agreed in the conclusions that mast is poisonous to cattle but rather beneficial to horses and hogs. Some say that the coarse hulls or cups clog the digestive tract and cause unthriftiness; others that there is actually poison in the mast. That cattle are affected more seriously than hogs or horses may possibly be explained by the difference in the structure of the digestive organs.

In some localities tympanites is said to be produced in cattle that browse on the leaves and bark which are very strongly astringent. The white oak contains about 10 per cent of tannin. *Q. lusitanica* contains in addition to tannic acid mentioned before, from 2-4 per cent of gallic acid. That other plants of the order are injurious has been indicated by Freidberger and Fröhner who state that the European Beech produces violent colic, tetanus, mania and fits of madness resembling those produced by strychnin; that the autopsy shows lesions resembling strychnin poisoning. They recommend giving tannin, morphin and chloral hydrate.

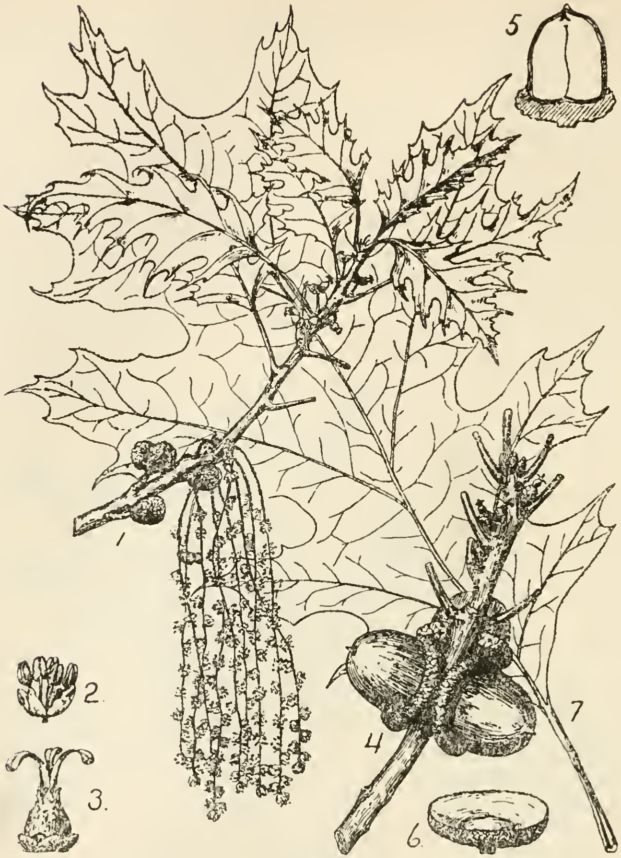

Fig. 184. Red Oak (*Quercus rubra*). 1. Flowering branch. 2. Staminate flower, enlarged. 3. Pistillate flower cluster, enlarged. 4. Fruiting branch, enlarged. 5. Acorn. 6. Cupule. 1, 5, 6, one-half natural size. M. M. Cheney.

The alders (*Alnus glutinosa*) of Europe are used as ornamental trees. Several trees of the genus, on the Pacific coast, are fair sized and produce good timber. The birches are valuable both as ornamental trees and for the excellent quality of their timber. The white birch (*Betula alba*) of Europe is frequently cultivated and birch tar is obtained from it. Cherry birch (*B. lenta*) and yellow birch (*B. lutea*) produce most valuable wood which is used for interior finishing. Paper birch (*B. alba* var. *papyrifera*) is used for making spools and canoes. The black birch (*B. nigra*) is common along our streams. The common source of oil of wintergreen is the cherry birch. This oil resembles that obtained from *Gaultheria procumbens*.

URTICALES

Trees, shrubs, or herbs; flowers never borne in catkins; monoecious, dioecious, or polygamous; ovary 1-celled, superior. *Urticales* are divided into the

Ulmaceae, the elms; *Moraceae,* the mulberries, and *Urticaceae,* the nettles. The *Castlloa elastica* of Mexico, the bread nut tree of Central America (*Brosimum Alicastrum*) and the *Cecropia* of tropical America furnish rubber.

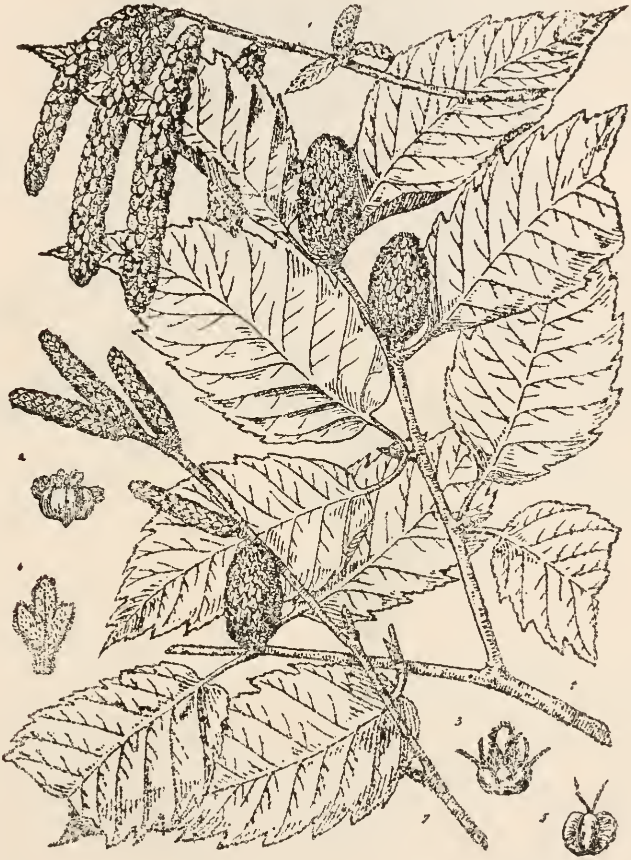

Fig. 185. Yellow Birch (*Betula lutea*). Flowering branch. 2. Staminate flower, enlarged. 3. Pistillate flower, enlarged. 4. Fruiting branch. 5. Nut, enlarged. 6. Scale of fruiting catkin, enlarged. 7. Winter branch, showing staminate catkin. 1, 4, 7, one-half natural size. (After M. M. Chency, In Green's Forestry of Minnesota.)

The family *Moraceae* contains the bread fruit (*Artocarpus incisa*) an important article of food for the natives of the Pacific Islands, and the jack fruit (*A. integrifolia*) the fleshy envelopes of which are, however, somewhat poisonous. Canoe-gum, a very good substitute for rubber, is obtained from this genus. The figs belong to this family also; the sycamore fig tree (*Ficus Sycamorus*) produces small fruit which is used in Egypt for food. The common fig (*Ficus Carica*) is the most valuable; it includes the common and Smyrna fig of commerce, containing 60-70 per cent of grape sugar. The India rubber tree (*F. elastica*) is the source of some of the India rubber. The ban-

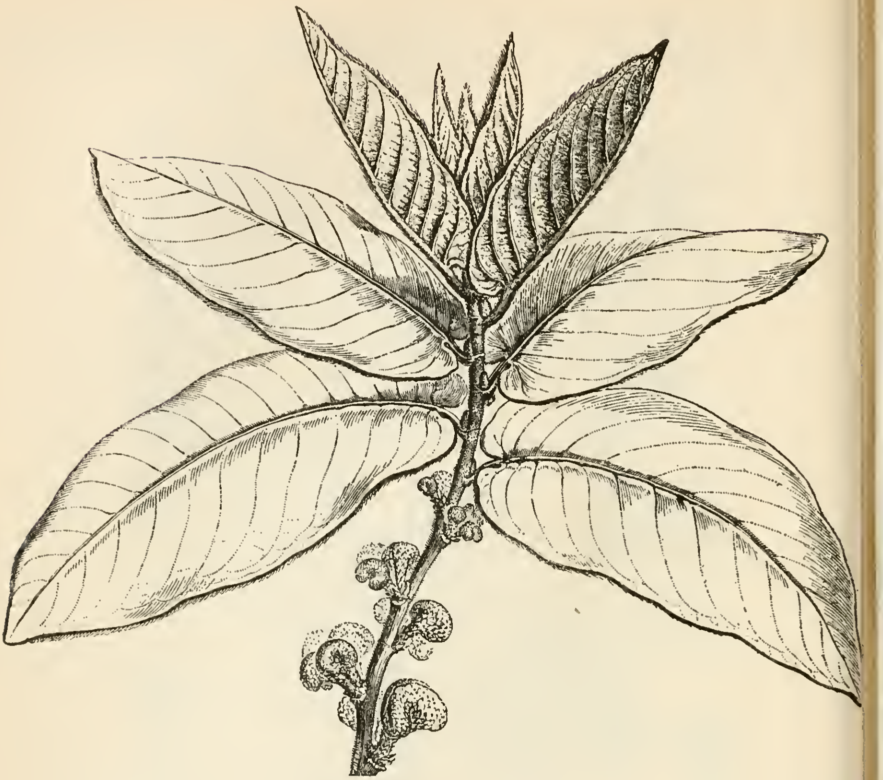

Fig. 186. Rubber-Tree (*Castilloa elastica*). Staminate flowering branch. A commercial rubber tree of Central America. (After Faguet.)

yan trees (*F. Benghalensis, F. religiosa* and *F. altissima*) of the East Indies furnish shellac. The mulberry (*Morus nigra*) is largely cultivated both for its fruit and for its wood, the latter being very durable for posts. The white mulberry (*M. alba*) is extensively planted, the leaves being used as food for the silk worm. The Osage orange (*Maclura pomifera*) of Arkansas, Indian Territory and Texas produces a very durable wood used for posts and pulley blocks. The fruit is said to be poisonous. The wood of fustic (*M. tinctoria*) of the West Indies is used for many purposes. The bark of the paper mulberry (*Broussonetia papyrifera*) is made into paper, and in Japan is also made into cloth. The paper mulberry is cultivated in the South.

The Upas tree (*Antiaris toxicaria*) contains *antiarin* $C_{27}H_{42}O_{10}+H_2O$. This tree furnishes an arrow poison which the natives prepare from the plant. It is a semi-liquid greenish black substance. The poison acts on the brain and respiratory nerves, causing vomiting and loss of sensation.

Ramie grass cloth or China grass (*Boehmeria nivea*) produces a fine fibre but it is difficult to separate it from the bark and wood. The hop (*Humulus Lupulus*) is cultivated and is the source of the oil of hops which imparts an aromatic, bitter flavor to beer. It contains *lupulin* which is a tonic and slightly narcotic. The elms are commonly cultivated as shade trees. The best is the American

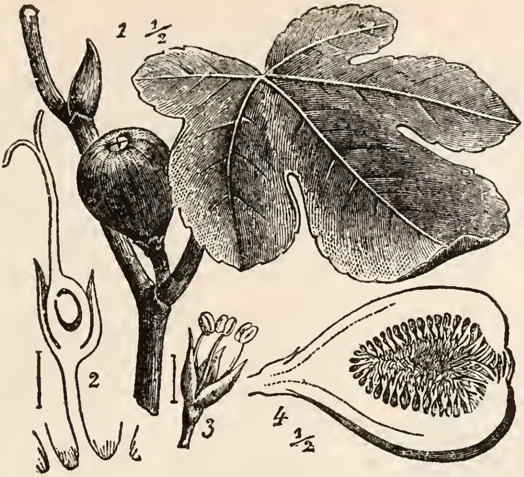

Fig. 187. Fig-tree (*Ficus Carica*). 1. Flowering branch. 2. Pistillate flower cut through longitudinally. 3. Staminate flower. 4. Fig in longitudinal section. (After Wossidlo.)

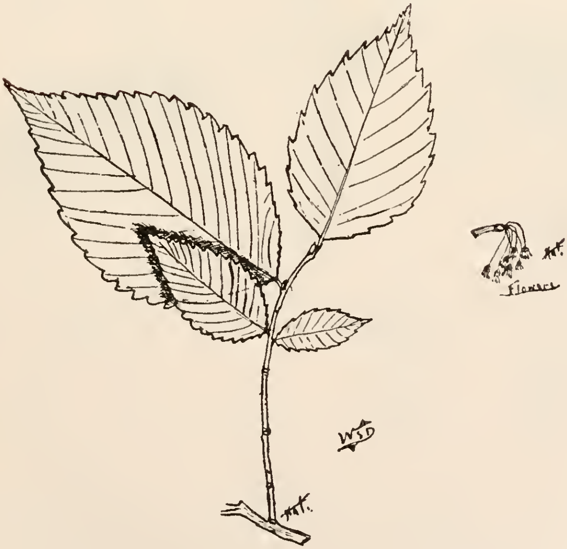

Fig. 188. Flowers and leaves of the American Elm (*Ulmus americana*). A familiar tree furnishing an important commercial wood. (W. S. Dudgeon.)

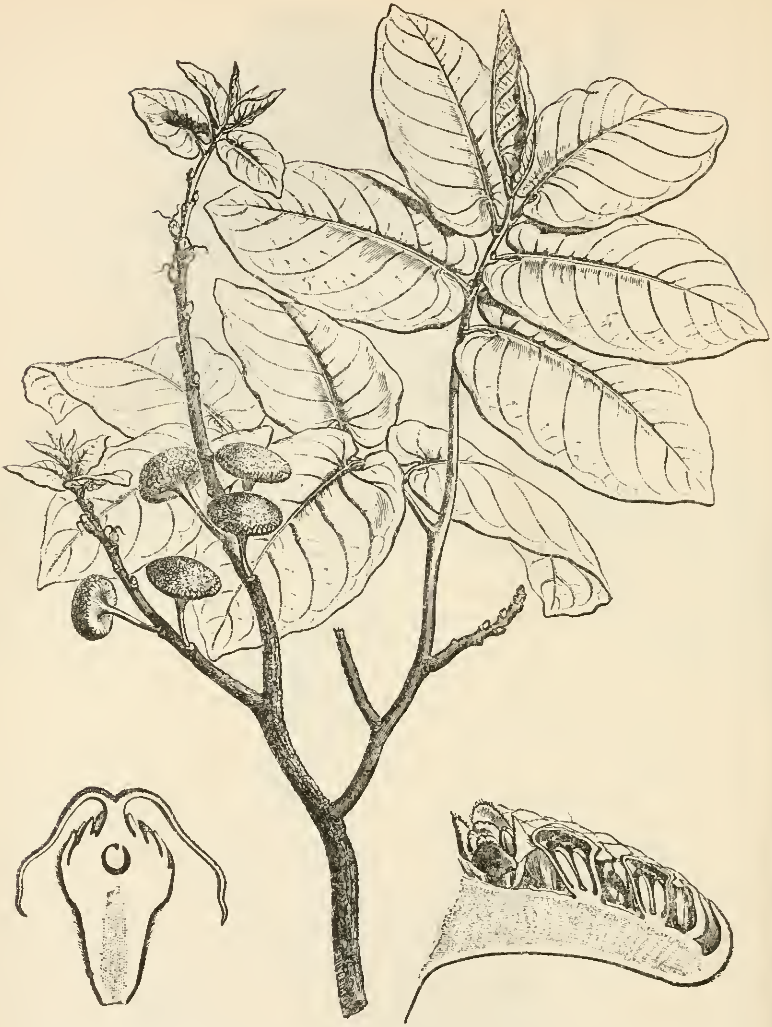

Fig. 189. Deadly Upas Tree (*Antiaris toxicaria*). Flowering branch; portion of staminate flower; longitudinal section of pistillate flower. (After Faguet.)

elm (*Ulmus americana*) which supplies a wood used largely in the manufacture of chairs. The partly ornamental elms are rock elm (*U. racemosa*) and slippery elm (*U. fulva*). The bark of the latter is used in medicine. The rock elm is used in the manufacture of bicycles; the wood taking a pretty finish. One of the common elms of Europe, cultivated in the United States, is the *U. campestris*. The *U. montana* is the Scotch elm. The hackberry (*Celtis occidentalis*) is a valuable shade tree and furnishes pretty wood which is difficult to work. The *Chlorophora excelsa* is one of the best timber trees of West Africa.

URTICACEAE. Nettle Family

Herbs, trees, or shrubs with stipules; flowers monoecious or dioecious, rarely perfect; calyx from the 1-2-celled ovary which forms a 1-seeded fruit; stamens as many as the lobes of the calyx or sometimes fewer; opposite, ex-albuminous or albuminous; when albuminous the radical points upward; cotyledons broad. A small family of 500 species some of which, like *Boehmeria,* produce valuable fibers. The leaves of *Pilea pumila* are demulcent and are said to be valuable in Rhus poisoning.

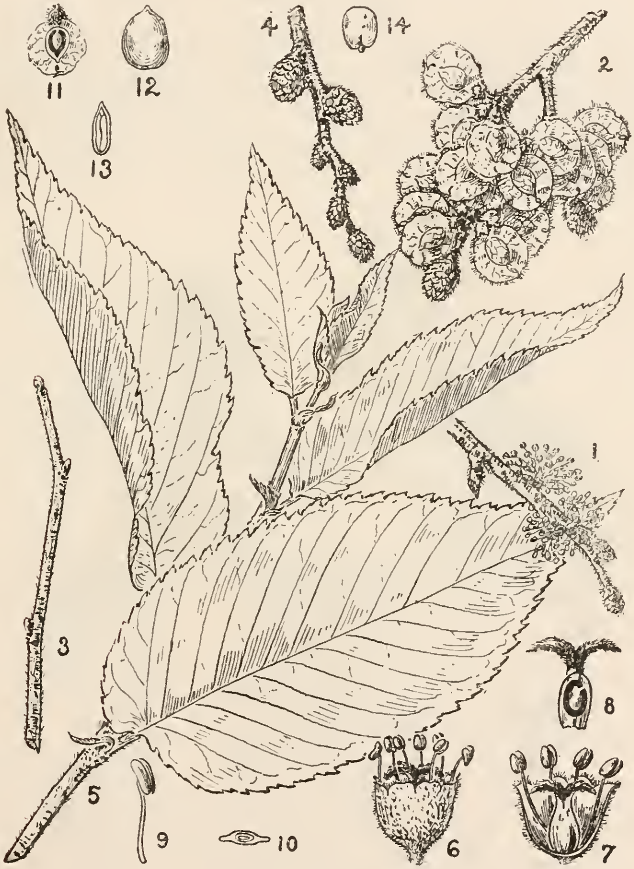

Fig. 190. Slippery Elm (*Ulmus fulva*). 1. Flowering branch. 2. Fruiting branch. 3. Winter branch with buds. 4. Same showing flower buds beginning to enlarge. 5. Summer branch. 6. Flower enlarged. 7. Longitudinal section of flower, enlarged. 8. Longitudinal section of pistil, enlarged. 9. Stamen, enlarged. 10. Cross section of ovary, enlarged. 11. Longitudinal section of fruit. 12. Seed, enlarged. 13. Longitudinal section of seed, enlarged. 14. Embryo, enlarged. 1, 2, 3, 4, 5, 11, one-half natural size. (After M. M. Cheney, in Green's Forestry in Minnesota.)

Genera of *Urticaceae*

Herbs with stinging hairs.
  Leaves opposite; flowers 4-parted..2. Urtica.
  Leaves alternate; staminate flowers 5-parted..................3. Laportea.
Herbs or trees without stinging hairs.
  Herbs; pistillate flowers spiked..1. Cannabis.
  Trees; staminate flowers racemose.............................4. Maclura.

1. *Cannabis,* Tourn. Hemp

Dioecious herbs with tough fiber to the inner bark; greenish flowers; sepals 5 in the staminate, 1 in the fertile flower; achene, crustaceous.

Cannabis sativa, L.

Stem from 4-8 feet high with broad, divided leaves, the linear-lanceolate segments sharply and closely serrate; greenish flowers with narrow staminate panicles and erect pistillate spikes, the sterile with 5 sepals and 5 stamens, fertile flowered spiked, with 1 sepal; fruit hard ovoid, achene oblong.

Distribution. Native to Europe and Asia and in waste places from New Brunswick to Tennessee, Kansas and Minnesota.

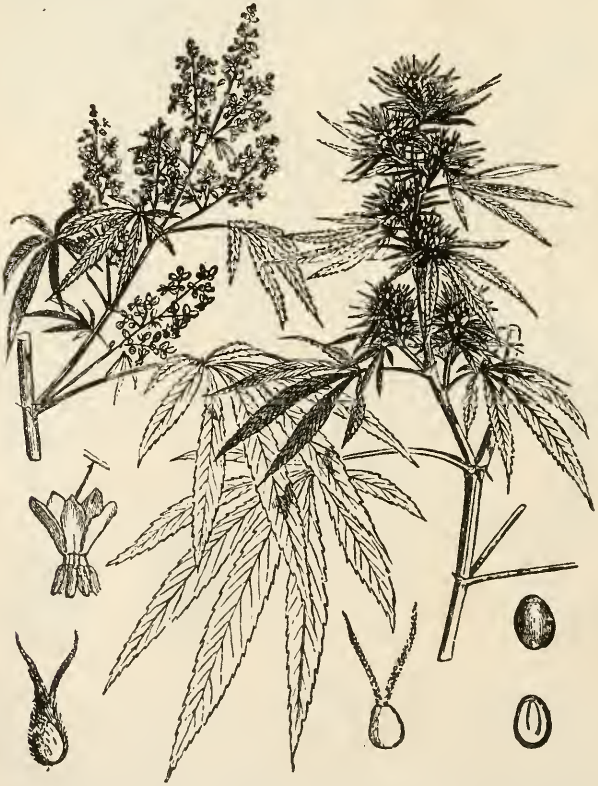

Fig. 191. Hemp (*Cannabis sativa*). Staminate and pistillate flowering branches; fruit; longitudinal section of fruit. (After Faguet.)

Poisonous Properties. The resinous secretions of this plant possess very powerful medicinal properties which, however, are said not to be produced by the plant when grown in temperate climates.

Indian Hemp (*Cannabis indica*) is probably not essentially different from the common hemp and has been used in medicine for a long time. According to Dr. Houghton and Mr. Hamilton the American grown product is equal to the Indian Hemp.

The use of hemp seems to have spread through India, Persia and Arabia during the early middle ages. The Hashishin, a sect of the Moravians, killed a large number of the Crusaders during the 11th and 12th centuries by the use of hemp as an intoxicant. The drug is largely grown in India and Turkestan. The form of hemp commonly reached by commerce is called Bhang or Hashish and consists of dried leaves and small stalks frequently mixed with fruits. This is smoked in India with or without tobacco. Ganjah is obtained from the flowering shoots of the female plant or stalk, a stiff woody stem several inches long which is pruned to produce flowering branches. The tops of these are collected then pressed by being trodden by the feet. From this mass comes the drug known as ganjah. It grows in an altitude of six thousand feet. The other forms of the plant consumed in India are Bhang and Charras. Subjee or Bhang is used for smoking. The narcotic ingredient found in *majun* and *charras* is undried resin which is obtained by the natives who, when passing among plants wear rubber aprons to which the resin adheres, after which the product is scraped together. The principal constitutents of hemp are resin and a volatile oil. The oil or amber colored substance has an oppressive hemp-like smell, and furnishes a resinous substance, *cannabin* which crystalizes in needles and acts like strychnin. *Cannabinol,* with intoxicating properties, is obtained from *cannabin* and is a product from the glands of *Cannabis*. *Cannabin hybrid* ($C_{18}H_{22}$) is a substance with the coniin-like odor; it is antispasmodic and soporific, and anodyne and a nerve stimulant. Dr. C. F. Millspaugh referring to the products of plants affording this oil concluded from experiments made, that this drug causes depression, epilepsy, vertigo, congestion, followed by cephalalgia, ear-ache, tooth-ache, dryness of mouth, throat, lips and lids; it produces nausea, vomiting after coffee, palpitation of the heart, weakness of the limbs and dreaminess during sleep. It produces the same symptoms in animals.

The stem of hemp is used by the Mohammedans who smoke it in combination with other substances. They also smoke the sun-dried leaves. It is intoxicating and restful to the smoker and alleviates pain, increases the appetite, causes sleep, and induces cheerfulness. It also produces violent coughing and nose bleed.

Hemp is most important in China, and other Asiatic countries, for the manufacture of cordage. The growing of hemp for the same purpose is also carried on to some extent in Nebraska and Kentucky. The seeds of the plant furnish food to birds.

2. *Urtica* (Tourn.) L. Nettle

Herbs with stinging hairs; flowers greenish, monoecious or rarely dioecious, clustered; staminate, with 4 stamens; fertile, with 4 sepals in pairs; fruit an erect, ovate, flattened acheme. A small genus of 30 species.

Urtica gracilis Ait.

A perennial from 2-6 feet high, sparingly bristly; leaves ovate, lanceolate with slender petioles; long, accuminate, sharply serrate, 3-5-nerved, the slender petioles sparingly bristly; flowers dioecious or with staminate and pistillate clusters. The stinging hairs of this and other species of the genus contain formic acid. A common weed in dry or moist ground along fence rows from Canada to British Columbia, Kansas and North Carolina.

Poisonous properties. The nettle and some other plants produce what is commonly called "urticaria" or nettle rash. It is an inflammatory disorder with a burning and itching sensation. It may come out in large or small patches, remaining for a few minutes or several hours and may disappear as abruptly. It usually leaves no trace behind. The nettle is supposed to contain an irritant toxic principle, *formic acid,* but recent studies seem to indicate that the urticaria is probably caused by one of the toxins.

The following species of the genus have urticating properties: *Urtica membranaceae, U. spatulata* and *U. pilulifera.*

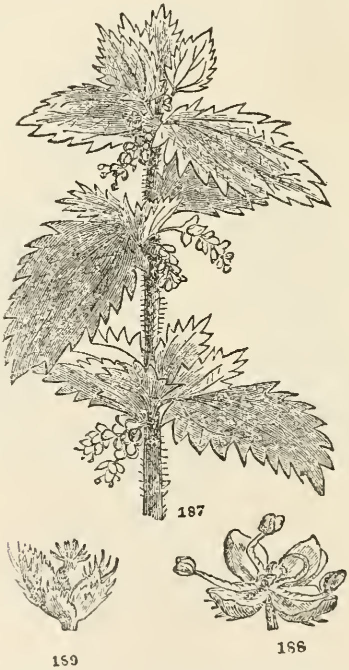

Fig. 192. Stinging Nettle (*Urtica urens*). (From Darlington's Weeds and Useful Plants.)

Urtica urens L. Small Stinging Nettle

An annual from 1-2 feet high; stem 4-angled, tough, branching with a few stinging virulent hairs; leaves elliptical or ovate, serrate or incised, with scattered stinging hairs; flowers loose or in racemose spikes; sepals 4 petals 4; fruit straight, ovate, flattened achene.

Distribution. From New Foundland to Florida and also on Pacific Coast.

Poisonous properties. This nettle has been used in medicine but it is not officinal. Formerly it was used for flagellation of the skin.

Urtica holosericea Nutt

A tall perennial with stinging hairs; leaves thick, oblong, ovate or ovate-lanceolate; flowers in open panicles.

Urtica dioica L. Stinging Nettle

An erect perennial; leaves and stems beset with stinging hairs; leaves thin, ovate, long petioled, acute or acuminate at the apex, cordate at the base, sharply serrate; flowers in large clusters, cymose-paniculate, often dioecious.

Distribution. Native to Europe but largely naturalized in North America from Atlantic coast to Minnesota and Missouri.

Poisonous properties. Poisonous like the preceding

3. *Laportea* Gaudichaud. Wood Nettle.

Perennial herbs with stinging hairs; flowers monoecious or dioecious in loose cymes, the lower mostly sterile; staminate flowers with 5 imbricated sepals; 5 stamens and a rudimentary ovary; pistillate flowers with 4 unequal sepals; stigma elongate, awl-shaped; achene ovate flat; endosperm scant or obscure. About 25 species in warm countries.

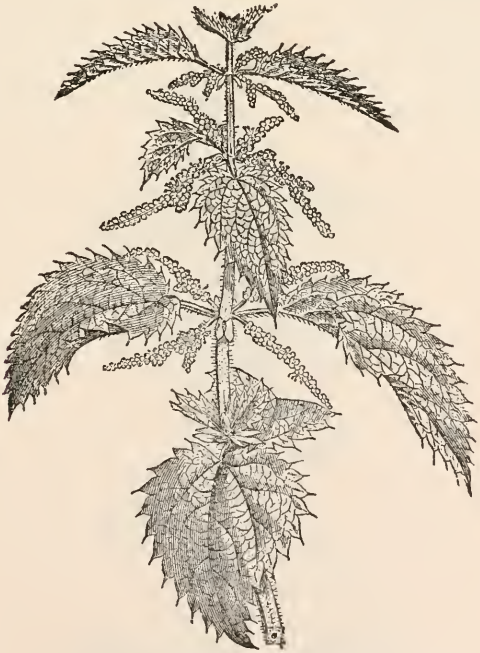

Fig. 193. Common Nettle (*Urtica dioica*). Sometimes causes urticaria. (From Johnson's Med. Bot. of N. A.)

Laportea canadensis Gaudichaud. Wood Nettle.

Perennial stem 2-3 feet high; leaves ovate, pointed thin, long-petioled, sharply serrate; fertile cymes divergent; achene smooth, as long as the calyx.

Distribution. In rich woods from Nova Scotia to Minnesota and Kansas and south to Florida.

Poisonous properties. It acts similarly to nettle, the poisonous action being even more pronounced. *L. crenulata, L. gigas,* and *L. stimulosa* also possess similar properties.

Maclura Nutt. Osage Orange.

Tree with milky juice; leaves alternate, pinnately veined; stipules caducous; stout, axillary spines; flowers dioecious, staminate in loose, short racemes with 4-parted calyx and 4-stamens; pistillate, capitate with a 4-cleft calyx enclosing the sessile ovary and long exserted style; fruit an achene surrounded by a fleshy calyx; endosperm none; embryo curved; it contains a single species named *Toxylon* by Rafinesque.

Maclura pomifera (Raf.) Schneider. Osage Orange

A tree 30-50 feet high; leaves ovate to oblong, lanceolate, pointed, mostly rounded at the base, green and shining; the syncarpous fruit is globose, yellowish green 2-4 inches in diameter; the wood is hard and tough and is used in the manufacture of wagons for paving, fencepost, etc. The tree is extensively planted as a hedge plant.

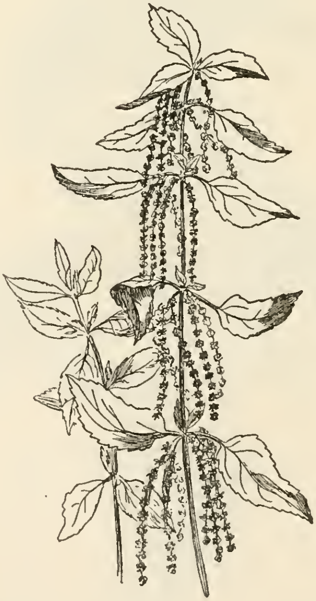

Fig. 194. Wood Nettle (*Laportea canadensis*). A common wood plant causing urticaria. (C. M. King.)

Distribution. In rich woods from Missouri to Kansas to Texas; widely cultivated in the north from southern Nebraska to southern Iowa, Illinois and eastward.

Poisonous properties. This species is listed as poisonous by Professor Bessey in Nebraska. Dr. Halsted notes that a friend of his while working in Osage Orange hedges suffered considerably because of inflamation following the piercing of the thorn. The writer had a similar experience.

Dr. Bessey says: "The Osage Orange (*Maclura pomifera*) which has been shown by Dr. Halsted to be more or less harmful as an external poison, is very commonly grown in the southern portion of the state, and it thus adds another to the plants to be avoided by some people. Although I am quite sensitive to some of the external poisons, I have myself never experienced any bad effects from handling the leaves or fruit of the Osage Orange."

PROTEALES

The proteales include one family, the *Proteaceae,* with nearly 1000 species, native to the tropics, mostly of the southern hemisphere.

SANTALALES

Herbs or shrubs generally parasitic; flowers solitary or clustered without corolla; calyx present, imperfect or perfect; pistil 1. Of the two families in the United States, the *Loranthaceae* contains the Southern mistletoe (*Phorandendron*) parasitic upon various decidious trees like the oak and elm; the *Arceuthobium* of Europe, and the Rocky Mountains; species parasitic upon conifers, one also occuring on spruce trees in eastern North America. Hyams is authority for the statement that the berries of *Phoradendron flavescens* are poisonous to children. Several deaths have been attributed to them. *Santalaceae* contains the fragrant sandalwood (*Santalum album*) of the Indian-Malayan region which contains an oil used in medicine for venereal diseases and for

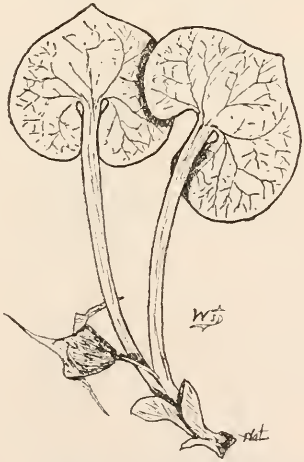

Fig. 195. Wild Ginger (*Asarum canadense*). Wild ginger is used in medicine. The roots are spicy fragrant; some plants related to it are poisonous. (W. S. Dudgeon.)

perfumes. The bastard toadflax (*Comandra umbellata*) of our northern woods is parasitic upon the roots of flowering plants. The family *Balanophoraceae* consists of chlorophylless parasitic plants with twining or acaulescent stems, and is native in tropical woods and savannas of Java, India and Australia.

ARISTOLOCHIALES

Plants with twining or acaulescent stems; leaves cordate or reniform; flowers perfect; calyx inferior, the tube adnate to the ovary or partly so; corolla none; ovary generally 6-celled. There are only three families, one of which occurs in North America. The *Aristolochiaceae* includes the wild ginger of the North (*Asarum canadense*) which is more or less purgative and probably also to be regarded as suspicious; its rhizome furnishing the substance *asarin* and a volatile oil which is used in perfumery; the *A. europaeum,* listed by Lehmann as poisonous because of its purgative action and blistering proper-

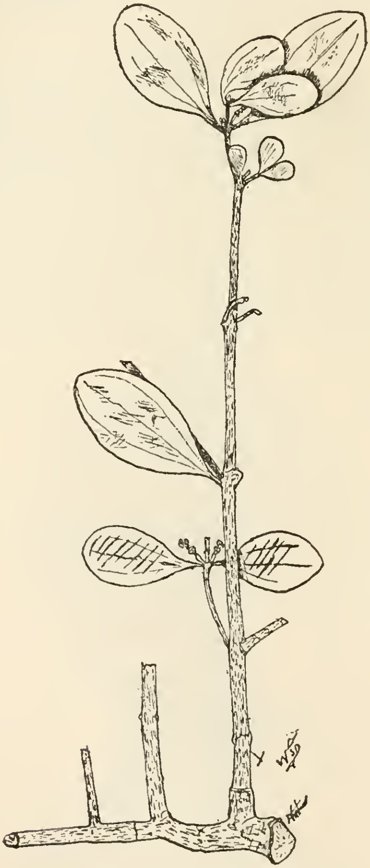

Fig. 196. Southern Mistletoe (*Phoradendron flavescens*). The berries of this plant are said to be poisonous. (W. S. Dudgeon.)

ties; the Dutchman's pipe (*Aristolochia macrophylla*) frequently cultivated and hardly as far north as Minnesota and Wisconsin; the gooseplant (*Aristolochia grandiflora*) of Brazil whose flowers emit an offensive odor, but in spite of this fact the plant is cultivated in greenhouses; Virginia snakeroot (*Aristolochia Serpentaria*) the root stock of which is used as a tonic and contains a volatile oil *borneol,* a bitter poisonous principle *aristolochin* $C_{32}H_{22}N_2O_{13}$ and the alkaloid *aristolochinin.* The European (*A. Clematitis*) produces colic and other gastric disturbances and is listed among the pungent narcotic poisons. The substance *asarin* when heated is irritating.

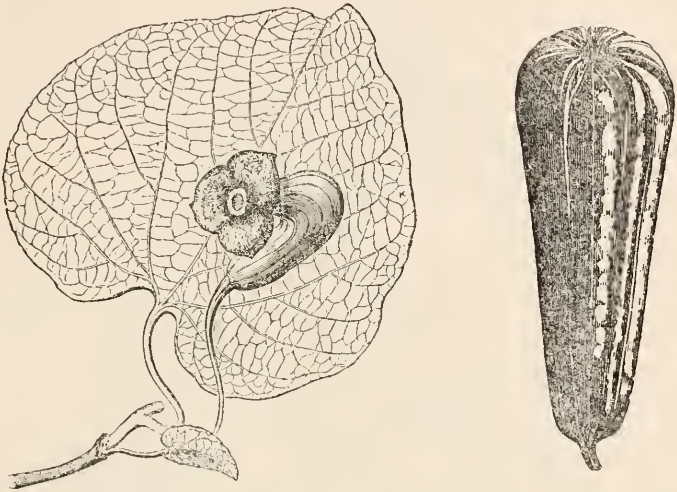

Fig. 197. Dutchman's Pipe (*Aristolochia macrophylla*). Leaf and flower. dehiscent fruit. (After A. Faguet.)

Several species of the genus *Aristolochia* are used as antidotes against snake-bites and this use is clearly indicated in some of the specific names, as in Virginia snakeroot (*A. Serpentaria*). Other plants of the genus are said to be poisonous, *A.grandiflora* being an example of this. The Arabs use *A. sempervirens* and *A. indica* as snake poison antidotes. According to R. B. White, the Guaco (*A. mexicana*) is a cure for snake-bites. Many other plants are used for the same purpose, several composites being well-known remedies. Among the latter are *Liatris squarrosa, Cacalia tuberosa,* and *Prenanthes alba.* Other plants having the same qualities belong to the families *Ranunculaceae, Orchidaceae, Violaceae, Polygalaceae, Liliaceae, Umbelliferae, Filices,* and *Palmae.* One has only to look through such works as the Robinson and Gray's Manual, or Britton's Manual, or various old medical works for the common names of plants with the word snake attached to them, to understand how prevalent was the belief that these plants were antidotes against the bite of venemous snakes.

POLYGONALES

Herbs, shrubs, or trees, often climbing vines; leaves alternate or occasionally opposite; jointed stems; flowers small, regular, dioecious, monoecious or polygamous; calyx 2-6 cleft or parted, inferior; stamens 2-9, inserted near the

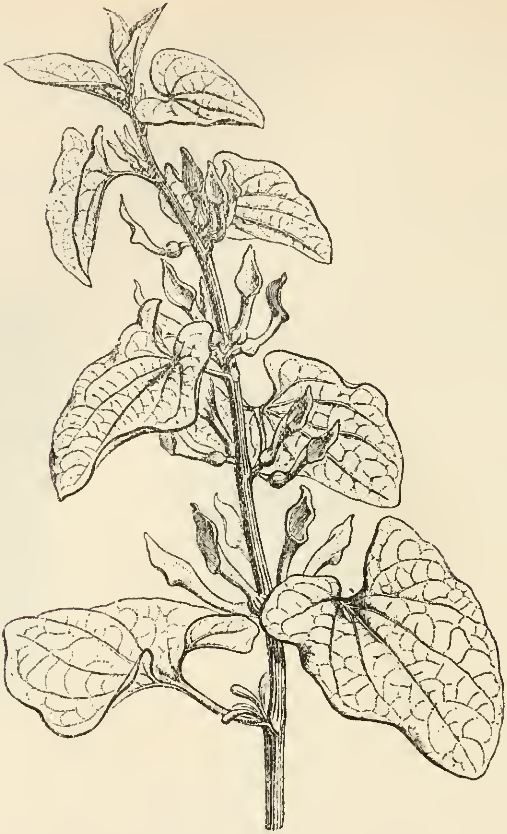

Fig. 198. European Aristolochia (*Aristolochia Clematitis*). Flowering stem. Listed as a narcotic poison. (After Faguet.)

base; pistil 1 with superior ovary; fruit an achene; endosperm mealy. Contains a single family (Polygonaceae).

POLYGONACEAE. Buckwheat Family

Herbs, shrubs, or trees, often climbing; jointed stems; stipules in the form of sheaths; juice often acrid or acid; leaves alternate or occasionally opposite; flowers small, regular, mostly perfect; calyx more or less persistent; ovary 1-celled, bearing 2-3 styles or stigmas and a single erect ovule; fruit an achene, 3-4-angled or winged, invested by the calyx; embryo curved or nearly straight; endosperm mealy, copious. About 800 species. Of economic importance are the pie plant (*Rheum Rhaponticum*); and rhubarb (*R. officinale*) of Thibet, the root of which contains cathartic acid and is a powerful cathartic; it also contains *chrysophan* $C_{27}H_{30}O_{14}$, *emodin* $C_{15}H_7O_2(OH)_3$, *rhein* $C_{15}H_6O_2(OH)_4$ and *chrysophanic acid* $C_{15}H_8O_2(OH)_2$. It is purgative and astringent. The canaigre (*Rumex hymenosepalus*) produces a thick root valuable for tanning leather. It is a native of the southwest. The tannin is the same as that found in rhubarb, and rheotannic acid. The patience dock *R. Patientia*), pale dock (*R. altissimus*) and curled dock (*R. crispus*) are troublesome weeds; French sorrel (*R. scutatus*) is cultivated in Europe and used as a salad. The presence of the silver plant of the west (*Eriogonum umbellatum*) is said to be indicative of gold and silver. *Muehlenbeckia platyclados* of the Samoan Islands is frequently cultivated in greenhouses. The mountain sorrel (*Oxyria digyna*) is used as a salad plant.

Genera of *Polygonaceae*

Sepals 6; stigmas 3..2 Rumex.
Sepals 5, occasionally 4, erect in part.
  Achenes triangular or lenticular.
    Embryo slender curved around one side of the endosperm 3 Polygonum.
    Broad cotyledons of embryo twisted and plaited.........1 Fagopyrum.

1. *Fagopyrum* (Tourn.) L. Buckwheat

Annual or perennial; somewhat fleshy, smooth, leafy herbs with erect stems; leaves petioled and alternate; hastate or deltoid flowers, small, white, or greenish, paniculately-racemose, perfect; calyx 5-parted, persistent, the divisions like petals; stamen 8; ovary 1-celled, 1 ovule, style with 3 divisions; fruit an achene, 3-angled; endosperm mealy; cotyledons broad. About 6 species native to the old world.

Fagopyrum esculentum Moench. Buckwheat

Smoothish plants; leaves hastate, abruptly narrowed above the middle; sheath half-cylindrical; racemes somewhat panicled, many flowered; sepals white, fragrant, with 8 honey-bearing yellow glands situated between the stamens.

Distribution. A common escape in eastern North America. Native of Eastern Europe and Western Asia.

Fagopyrum tataricum (L.) Gaertn. India-wheat

Annual, similar to the above species; leaves deltoid, hastate;flowers smaller; pedicel short.

Distribution. In waste places from eastern Canada to New England. Native to Asia.

Poisonous properties. Fagopyrum contains the glucoside *indican* $C_{26}H_{31}NO_{17}$ found also in *Nerium* and other plants. The plant produces bloat especially if consumed before bloom.

Several years ago the writer received a complaint from a farmer stating that the feeding of buckwheat had produced a rash upon his hogs. Feeding of buckwheat and the eruptions or urticaria following are well known to veterinarians.

Dr. Millspaugh says of buckwheat:

> Many individuals cannot partake of pancakes made from the flour of the seeds without experiencing a severe itching especially observed about the large joints. A peculiarity of this itching is that it occurs after the removing of the clothing and when first retiring at night. The eruption incident to and following this itching takes the form of vesicles which degenerate into dry, dark colored scabs. Another symptom arising is a glutinous condition of otherwise natural feces, making expulsion quite difficult. Increased urinary discharge is also present in many cases.

2. *Rumex.* L. Dock

Coarse herbs, with small, mostly green flowers, which are crowded on generally whorled, panicled racemes; petioles partly sheathing at base; 6 sepals; 3 outer herbaceous, sometimes united at base, spreading in fruit; 3 inner larger, slightly colored, enlarged after flowering and convergent on 3-angled achene, veined, often bearing a grain-like tubercle on the back; stamens 6; styles 3; stigmas tufted; embryo lying along one side of the albumen, slender, and slightly curved.

It has been claimed by some that the seeds of *R. Acetosella* poison horses and sheep.

Rumex altissimus Wood. Pale Dock.

A tall perennial from 2-6 feet high, glabrous with erect stem, simple or branched above; leaves ovate or oblong; lanceolate, long, acute, pale green, veins obscure; racemes spike-like or somewhat interrupted below, spreading

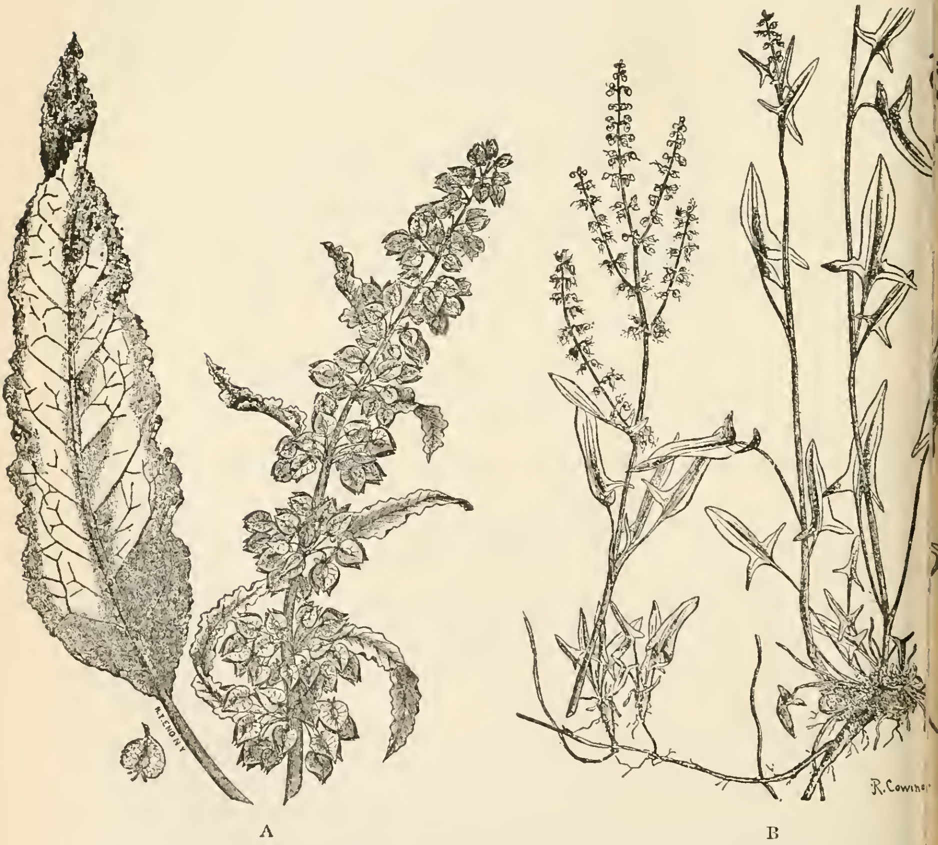

Fig. 199. Two weeds of the smartweed family. A. Sourdock (*Rumex crispus*). B. Sheep sorrel (*Rumex Acetosella*). Both have been suspected. They contain a great deal of oxalate of lime. (U. S. Dept. of Agr.)

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Pennsylvania Smartweed or Persicaria (*Polygonum pennsylvanicum*). Common in the North. Smut found on this plant is very irritating. (Ia. Geol. Sur., p. 421).

in fruit; pedicels nodding, shorter than the fruting calyx; valves broadly ovate with a conspicuous ovoid tubercle.

Distribution. Common throughout the northern part of the United States.

Rumex crispus L. Curled Dock

A smooth perennial from 3-4 feet high; leaves with strongly wavy and curled margins, lanceolate and acute; in the lower leaves bases are somewhat truncate or inclined to be ear-shaped; flowers collected in dense whorls, extended or prolonged into racemes, entirely leafless above, but below with small leaves; flower consists of 6 sepals, fruiting pedicels as long as the calyx wings; wings heart-shaped, erose dentate, each showing a tubercle; achene 3-angled, smooth.

Poisonous properties. The docks contain *rumicin* $C_{14}H_{10}O_4$, which is a tasteless, golden-yellow substance, slightly soluble in hot water. It acts as a rubefacient and discutient and is used for destroying parasites of the skin.

Rumex has found a place in Pharmacopoea and is also used in medical practise. It causes nausea, watery brown faeces, copious urination, a dry spasmodic cough, and perspiration. The *Rumex orbiculatus,* Great Water Dock, according to Dr. Johnson, is tonic, astringent, and slightly laxative.

Medical properties. It is used as a stimulant and diuretic.

3. *Polygonum* L. Smartweed

Annual or perennial herbs, occasionally woody; stem erect, climbing or floating; leaves alternate, entire, ochreae cylindrical, often fringed; flowers mostly perfect, green white, pink, or purple; calyx 4-5 parted or cleft; stamens 5-9, filaments filiform or dilated to the base; style 2 or 3 parted or cleft; achene lenticular or 3-angled, rarely 4-angled; endosperm present. About 200 species of wide distribution. The *P. tinctorium* of China furnishes the Chinese indigo. The Saghalen knotweed (*P. sachalinense*) was widely advertised as a forage plant a few years ago and is used in Japan and Manchuria as we use asparagus. The prince's feather (*P. orientale*) is cultivated for ornamental purposes. The tanweed (*P. Muhlenbergii*), smartweed (*P. Persicaria*), knotgrass (*P. aviculare*) and black bindweed (*P. Convolvulus*) are troublesome The Pennsylvania persicaria (*P. pennsylvanicum*) is a valuable honey plant and its seed is a common impurity in clover.

Polygonum Persicaria L. Lady's Thumb

A nearly smooth and glabrous annual from 12-18 inches high; leaves lanceolate or linear, marked with a lunar blotch near the middle, acuminate ochreae somewhat bristly; ciliate spikes ovoid or oblong, erect; stamens mostly 6; style 2-3 parted; achene lenticular.

Distribution. Across the continent in moist places; naturalized from Europe.

Poisonous properties. None of the species is relished by stock; the *P. acre* and *P. Hydropiper* are very acrid and produce gastro-enteritis and erythema, like that caused by buckwheat. The following species produce similar troubles.

Polygonum acre H.B.K. Water Smartweed

A nearly smooth perennial; stems rooting at the decumbent base; leaves linear-lanceolate; ochreae strigose, fringed with long bristles; spikes erect, panicled; flowers whitish or flesh colored; stamen 8; achenes 3-angled or 4-angled, smooth and shining.

Distribution. Common southward from Missouri to Louisiana, Texas and Mexico.

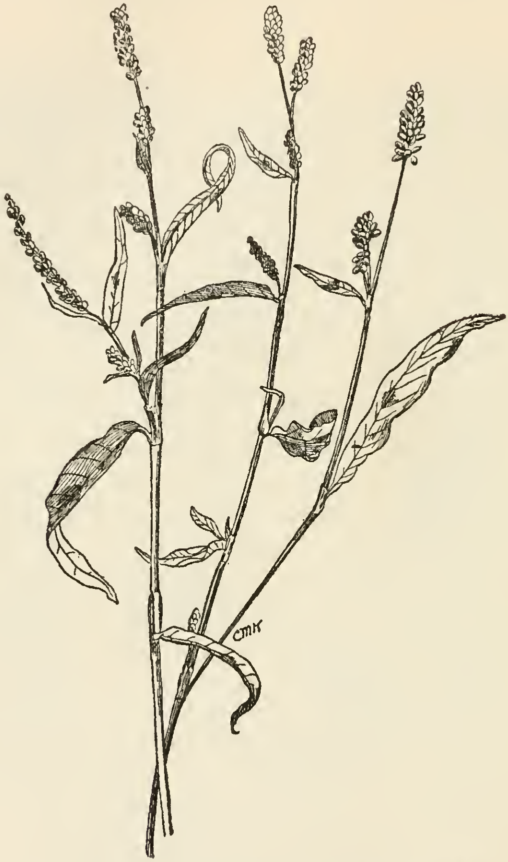

Fig. 200. Ladies' Thumb (*Polygonum Persicaria*). Common in moist places. (Charlotte M. King.)

Polygonum hydropiperoides Michx. Wild Water Pepper

A smooth, branching perennial, slightly or not at all acrid; 1-3 feet high; the narrow sheaths hairy, leaves narrowly lanceolate or oblong-lanceolate; spikes erect, slender, sometimes filiform; flowers small, flesh colored, or nearly white; stamens 8, style 3-parted to below the middle; achene 3-angled, ovoid or oblong, smooth and shining.

Distribution. In swamps or wet soils across the continent from New Brunswick to California, Florida and Mexico.

Polygonum Hydropiper L. Smartweed. Water Pepper

Smooth, erect annual, 1-2 feet high; stem often reddish; leaves linear-lanceolate, or lanceolate; spikes, nodding, usually short or interrupted; flowers

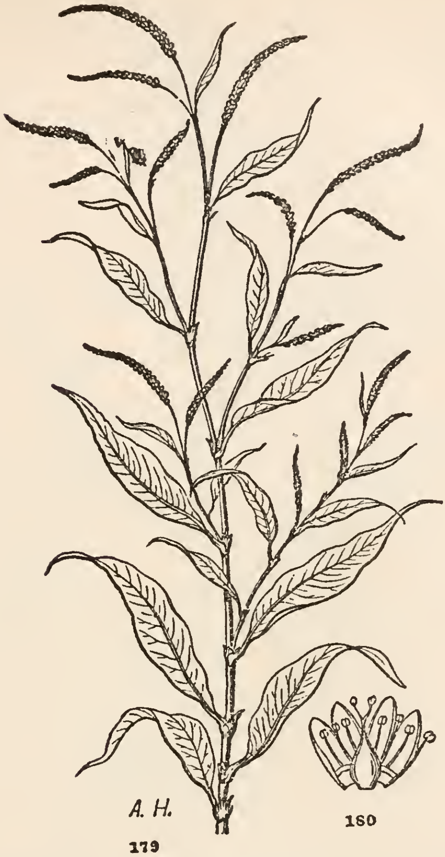

Fig. 201. Water Pepper (*Polygonum Hydropiper*). Troublesome to sheep. (After Hochstein.)

mostly greenish; stamens 4 or sometimes 6; ochreae cylindrical, fringed with short bristles; style short, 2-3 parted; achene lenticular or 3-angled, dull, granular.

Poisonous properties. This species and the door yard knot weed (*P. aviculare*) are said to be troublesome to sheep

CENTROSPERMAE

Herbs mostly with perfect flowers; calyx present; corolla, when present, polypetalous; ovary superior; perisperm present; embryo coiled, curled or annular; fruit not an achene. Generally fleshy plants, many found in saline soils. It includes the families *Chenopodiaceae, Amaranthaceae, Nyctaginaceae, Phytolaccaceae, Caryophyllaceae, Portulacaceae* and others. The last named contains the garden pussley (*Portulaca oleracea*), the moss pink (*P. grandiflora*), and the bitter root (*Lewisia rediviva*). The family *Aizoaceae* also of this order, contains the New Zealand spinach (*Tetragonia expansa*), and the ice plant

(*Mesembryanthemum crystallinum*). The family *Basellaceae* another of this same order contains the Madeira vine (*Boussingaultia baselloides*) commonly cultivated. The seeds of some species are edible.

Families of *Centrospermae*

Fruit an utricle.
  Flowers bractless or occasionally with bracts.
    Sepals green or greenish............................*Chenopodiaceae.*
  Flowers bracted.
    Sepals generally with scarious bracts.................*Amaranthaceae*
Fruit fleshy, a berry..*Phytolaccaceae.*
Fruit indurated into a nut-like pericarp, base of calyx constricted..*Nyctaginaceae.*
Fruit a capsule, dehiscent by teeth or valves.
    Sepals 5 or 4, distinct or united.......................*Caryophyllaceae.*

CHENOPODIACEAE. Goosefoot Family

Annuals or perennials, frequently succulent herbs, or rarely shrubs; alternate leaves without stipules; flowers small; greenish; petals absent; calyx free, stamens as many as the lobes of the calyx or fewer and inserted opposite them on their base; ovary 1-celled; fruit a 1-seeded, thin utricle or rarely an achene; endosperm mealy or wanting; embryo coiled.

About 500 species of wide distribution, common in arid regions. Some of the economic plants of this family are sugar beet (*Beta vulgaris*), a maritime plant of Europe, and spinach (*Spinacia oleracea*) from the orient. The beet is one of the most important plants of the family, being largely cultivated in Europe as a source of cane sugar although as late as 1800, its use in that capacity was of little extent. It is also an important plant for stock food and for human food. Spinach is used extensively for greens but, in Utah, is somewhat of a weed. The Australian saltbushes are well known forage plants. Indigo is derived from *A. hortensis*, a native of Tartary. The strawberry blite (*Chenopodium capitatum*) is cultivated in Europe for its leaves. The shrubby saltwort (*Suaeda fruiticosa*) is burned in the south of Europe for Barilla. The Russian thistle (*Salsola Kali.* var. *tenuifolia*) is used in much the same way. The Spanish wormseed (*S. Webbii*) contains an oil much like that found in *Chenopodium ambrosioides.* The tumble-weed (*Cycloloma atriplicifolium*) is common on the plains. The white sage (*Eurotia ceratoides*) is an excellent forage plant of the west.

Poisonous properties. The use of the beet leaves for fodder has sometimes caused bloat. It has been known for some time that the feeding of roots to animals causes the formation of renal calculi. These calculi consist of a combination of uric and phosphoric acid with lime. An experiment conducted by Prof. W. J. Kennedy and Mr. E. J. Robbins at the Iowa Experiment Station in coöperation with Prof. L. G. Michael indicated that sugar beets fed to rams will produce renal calculi. Prof. Michael says* in regard to the effect of mangels and sugar beets on the kidney:

> Both roots seem to affect the kidney similarly.
>
> A small calculus was found in one kidney of Ram VI. This ram was fed sugar beets. The membrane about the calculus and extending down into the urethra was pigmented, a decided black.

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* Biennial Rept. Iowa State College of Agriculture and Mechanic Arts 23:142.

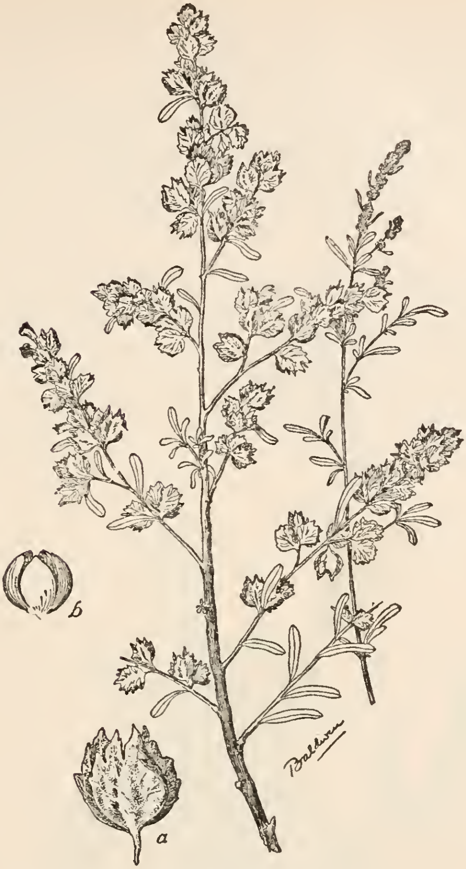

Fig. 202. Salt Bush (*Atriplex canescens*). A common plant of saline soil in the west. (U. S. Dept. of Agrl.)

In the kidney of Ram III the same kind of pigmentation occurred as in Ram VI. Ram III was fed Mangels. No calculus was present.

Miss S. Hartzell, who investigated the chemistry, reports as follows:

A post mortem examination of several valuable animals which the Experiment Station lost showed that renal calculi were present. This resulted in the metabolism experiment which was conducted by the Animal Husbandry Section in co-operation with the Chemical Section of the Experiment Station.

Thus far 42 rams have been used in the experiment, of which 11 were fed hay and corn; 9 were fed hay, corn and ensilage; 11 were fed hay, corn and mangels; 11 were fed hay, corn and sugar beets. In the case of those which were fed hay and corn, and also of those which were fed hay, corn and ensilage, the bladders and kidneys were normal while the results were the reverse in the case of those which were fed sugar beets or mangels along with the hay and corn. The sugar beets and mangels had the same effect The kidneys were larger than normal, the gall bladders were distended, the bladders were enlarged, often very much so, and in several cases the heart was enlarged. The kidneys in all cases were of a pale color. Three animals died during the experiment. The bladder of one was highly inflamed while in the other two the bladders contained calculi which were too large to pass thru the urethra. The kidneys of two of the animals were broken down while the third was much enlarged, and calculi were present. In one of the animals which was slaughtered the following conditions existed: bladder enlarged; ulcerated between ureters; kidney surface mottled; kidneys enlarged; cortex discolored; calyces full of calculi; gall bladder much enlarged; other organs normal.

According to Greshoff the leaf of *Kochia scoparia* contains saponin, as do the seeds of this species and of *K. arenaria.* A species of Atriplex native to China causes a skin disease known as "atriplicimus."

Genera of *Chenopodiaceae*

A spiny shrub...2. Sarcobatus.
Fleshy herbs.
    Embryo coiled into a spiral; calyx horizontally winged..........3. Salsola.

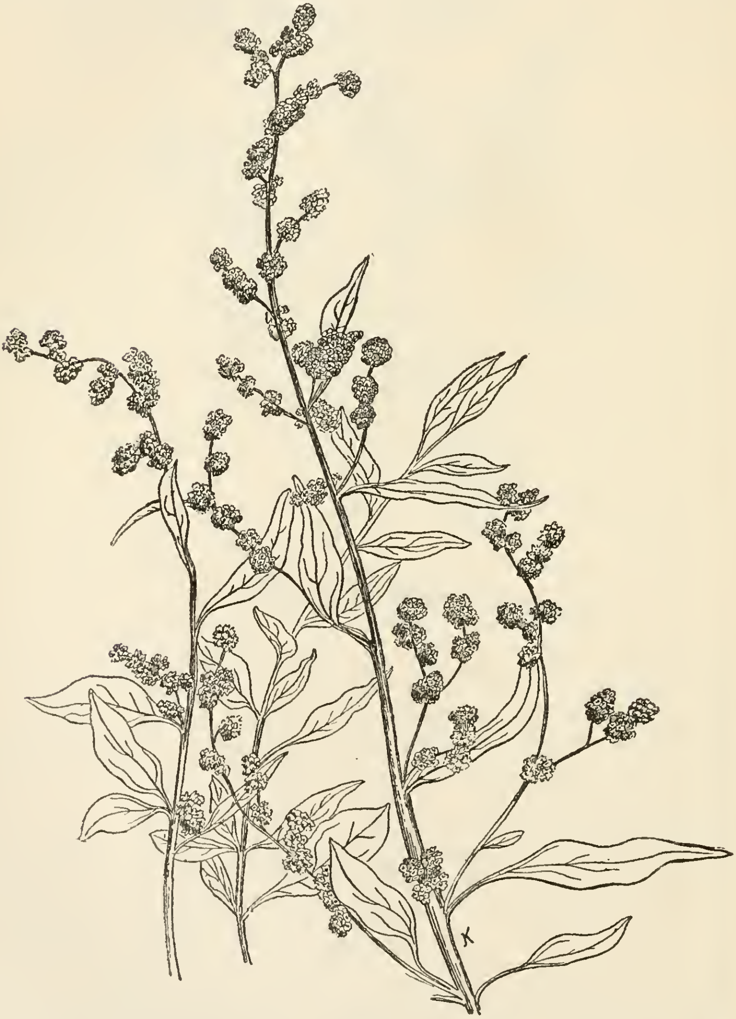

Fig. 203. Common Pigweed (*Chenopodium album*). Young shoots sometimes used in place of spinach. (Charlotte M. King.)

Seed with utricle; embryo coiled; calyx not horizontally winged...1. Chenopodium.

Chenopodium L. Pigweed. Goosefoot. Lamb's quarter

Annual or perennial herbs usually covered with a white mealy substance; flowers inconspicuous, in sessile, small clusters, collected in spikes or panicles, perfect; calyx 5-, rarely 4-parted or lobed; stamens generally 5; styles 2, rarely 3; ovary 1-celled, becoming a 1-seeded, thin utricle; embryo coiled around the mealy endosperm.

A small genus of about 60 species of wide distribution in saline soil, around dwellings and in manured soil. Several species like the common pigweed (*C. album*), the Australian spinach (*C. auricomum*), and the English Good King Henry (*C. Bonus-Henricus*), are used as a substitute for spinach. The quinoa (*C. Quinoa*) is an annual, native to Peru, which produces its flowers in dense, erect panicles. It is cultivated in Chili and Peru for its seeds, which are said to be very strengthening. It was the principal meal food of the Peruvians be-

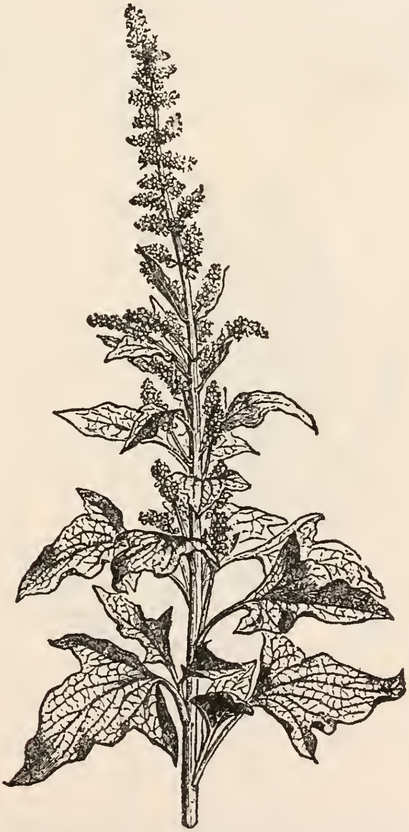

Fig. 204. Good King-Henry (*Chenopodium Bonus-Henricus*). Used as a substitute for spinach. (From The American Agriculturist.)

fore the conquest by Spain. An oil is obtained from the wormseed (*C. ambrosioides*). Several species of the genus like *Chenopodium album* and *C. hybridum* are weedy.

Chenopodium Botrys L. Jerusalem Oak

A more or less glandular, pubescent, aromatic annual; leaves with slender petioles, oblong, obtuse, sinuate, pinnatifid, flowers in leafless racemes; calyx 2-3 parted, dry in fruit, only partially enclosed.

Distribution. Naturalized from tropical America. Common in eastern North America to Oregon.

Chenopodium ambrosioides L. Mexican Tea. Wormseed

A smooth annual; leaves slightly petioled, aromatic, oblong, lanceolate, toothed or nearly entire; flowers in spikes, leafy or intermixed with leaves; calyx 2-3 parted; fruit dry, enclosed by the calyx.

Distribution. Naturalized from tropical America. Common in eastern North America to California. The fruit is officinal in the U. S. Pharmocopoeia.

Chenopodium ambrosioides L. var. *anthelminticum* (L.) Gray. Wormseed

An annual or perennial weed, glandular pubescent; leaves lanceolate, or ovate-lanceolate, acuminate at the apex and narrowed at the base, the lower

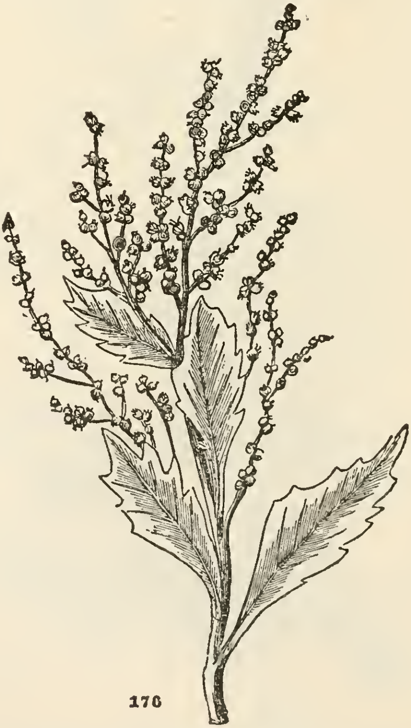

Fig. 205. Wormseed (*Chenopodium ambrosioides*). Fruit officinal. (From Darlington's Weeds and Useful Plants.)

laciniate pinnatifid; flowers in spikes without bracts, or the lower spikes leafy bracted.

Distribltion. Naturalized from Europe in waste places, from Massachusetts to Ontario and from Wisconsin to Mexico.

Poisonous properties. Several species of the genus contain volatile oils. The *C. ambrosioides,* var. contains the volatile oil of wormseed. This oil has a peculiar, strong, offensive odor and a pungent disagreeable, but aromatic taste. It is said to contain *chenopodin,* $C_6H_{13}NO_2$. In the case of a man who took about one half an ounce of a soluble oil of wormseed, Dr. Millspaugh says that the symptoms were those from a narcotic, acrid poison, affecting the brain, spinal cord and stomach. The patient was insensible, convulsed and foamed at the mouth. In another case a man who had taken a considerable quantity displayed hilarity and made futile attempts at talking like a drunken man. Death followed later. *C. mexicanum* contains *saponin.*

2. *Sarcobatus* Nees. Grease-wood

An erect, branched shrub with spiny branches; leaves alternate; linear, fleshy; flowers dioecious or monoecious; the staminate in terminal clusters without a calyx; the pistillate solitary in the axils with compressed calyx, adnate to the base of the papillose stigmas; in fruit a membranous horizontal wing; seed vertical; embryo green, coiled into a flat spiral. Species 1.

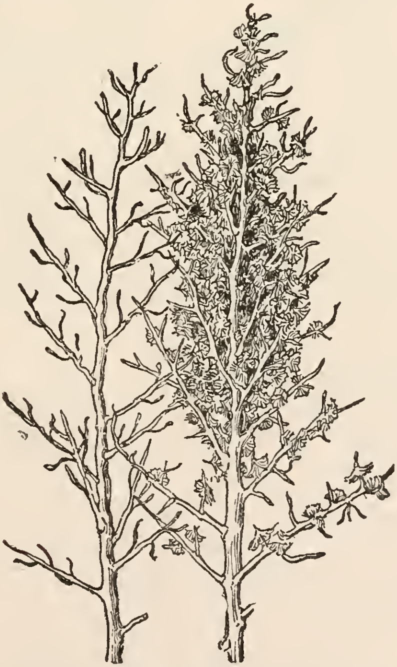

Fig. 206. Grease wood (*Sarcobatus Maximiliana*). A plant growing in alkaline soils in the Western United States. Poisonous to sheep. The sharp spines cause mechanical injury. (U. S. Dept. Agrl.)

Sarcobatus Maximiliani Nees, Torr. Grease-wood

A glabrous perennial with succulent foliage and spiny branches. Wood hard.

Distribution. In dry, alkaline soil from western Nebraska to New Mexico, Nevada, and Montana; most abundant west of the front Rockies.

Poisonous properties. Prof. Chesnut says:

> A correspondent in New Mexico states that on one occasion he counted as many as one hundred sheep that had been killed by eating the leaves of this plant. It is claimed that cows are not affected by eating it at any time and that sheep can eat it quite freely in winter. Death is perhaps due more to the bloating effect than to any poisonous substance which the plant contains.

It might be noted also in this connection that the sharp spines on the plant often inflict serious injuries to persons who come in contact with it and also to animals, setting up inflammation and causing the formation of pus. It is used as a forage plant.

3. *Salsola* L. Saltwort

Bushy branched herbs, succulent when young, but rigid at maturity; leaves terete, prickly-pointed and sessile; flowers sessile and axillary; calyx 5-parted, persistent, enclosing the depressed fruit, the divisions horizontal, winged on the back, enclosing the utricle; stamens 5; ovary depressed; style 2; embryo coiled in a conical spiral. About 40 species of wide distribution, saline soils.

Salsola Kali L., var. *tenuifolia* G. T. W. Meyer. Russian Thistle

An herbaceous, smooth or slightly pubescent annual, diffusely branched from the base; from 1½ to 3 feet high, spherical in the mature form; leaves fleshy, alternate, succulent, linear, subterete, 1-2 inches long, pointed in the older specimens; upper leaves in the mature plant persistent, each subtending 2 leaf-like bracts and a flower; stem and branches red; apetalous flowers solitary and sessile; calyx consisting of 5 persistent lobes, enclosing the dry fruit which is usually rose colored, about 1-12 of an inch long; 5 stamens, nearly as long as the calyx; pistils simple with 2 slender styles producing a single obconical depressed seed, dull gray or green, without albumen; embryo spirally coiled. The plant flowers in July or August.

Distribution. Common from Minnesota to Kansas, west across the continent, Illinois and Kansas to New Jersey.

Injurious properties. The Russian thistle not only clogs the harvesters and harrow, injures horses legs so that boots have to be put on them but is equally disagreeable to come in contact with, to man. On this point, Prof. Dewey says:

> The sharp spines on the plants not only irritate and worry both horses and men, but often, by breaking under the skin, cause festering sores on the horses' legs, so that in many localities it has been found necessary to protect them with high boots or leggings. In handling grain or flax, in the processes of hauling and threshing, the sharp spines cause considerable irritation and consequent loss of time.

AMARANTHACEAE. Amaranth Family

Herbs, or in some cases, shrubs; leaves simple, mostly entire; flowers small, green or white with bractlets, usually in terminal spikes or heads; petals none; calyx herbaceous or membranous, 2-5 parted; segments distinct or united;

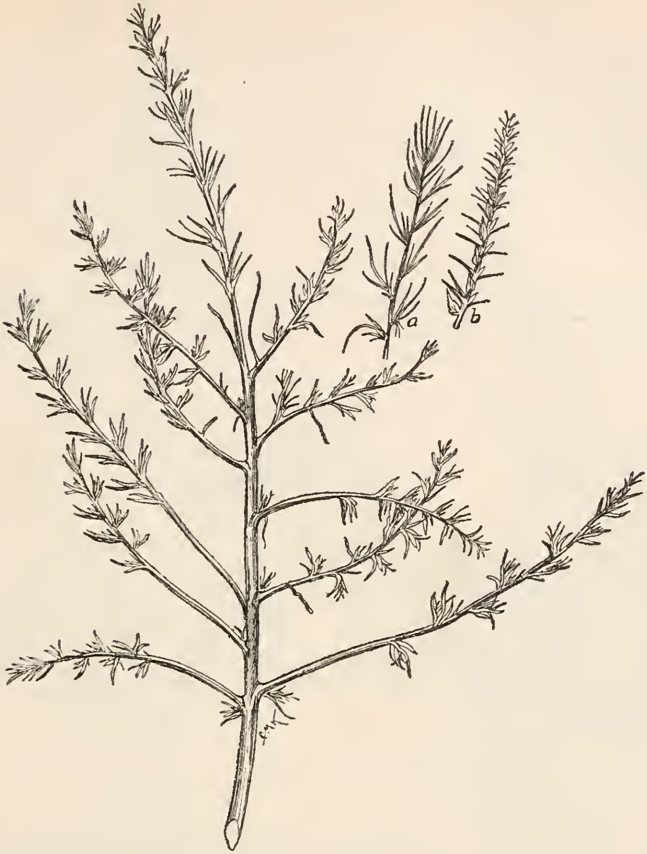

Fig. 207. Russian Thistle (*Salsola Kali*, var. *tenuifolia*). Causes mechanical injuries to man and stock. (Charlotte M. King.)

stamens 1-5, mostly opposite the calyx-segments; ovary 1-celled; ovules solitary; fruit an utricle; circumscissile, irregular or indehiscent; seed generally smooth; endosperm usually copious and mealy. About 425 species in tropical countries mostly. Several like *Celosia cristata* are cultivated for ornamental purposes and several are weedy. Among the latter are the tumble-weed (*Amaranthus graecizans*), pig-weed (*A. retroflexus*), and prostrate pig-weed (*A. blitoides*). The leaves of several species are used as food.

Amaranthus (Tourn.) L. Pig-weed. Tumble-weed

Annual, branching or erect herbs, smooth or pubescent leaves, simple; small flowers, monoecious, dioecious, or polygamous, green or purplish, generally with 3 bractlets; in spikes or axillary clusters; sepals 3-5, distinct; stamens 2-5; styles 2-3; fruit oblong, utricle. About 50 species of wide distribution, mostly of southern states.

Amaranthus retroflexus L. Pig-weed. Red Root

Roughish, slightly pubescent, annual with stout stems 2-4 feet high; leaves ovate or rhombic ovate; upper lanceolate, acute or acuminate at apex; flowers in dense spikes; bractlets about twice as long as the 5 scarious mucronate-tipped sepals; stamens 5; seed black.

Distribution. Naturalized from tropical America; found throughout the United States, especially on waste ground far northward. Also naturalized in Europe.

Amaranthus hybridus L. Slender Pig-weed

Similar to the preceding but with darker green or purple foliage; stem more slender, erect; leaves ovate or rhombic ovate, smaller than the preceding; spikes linear-cylindrical, forming dense terminal panicles; bracts subulate, twice as long as the acute or cuspidate sepals; stamens 5; utricle but slightly wrinkled.

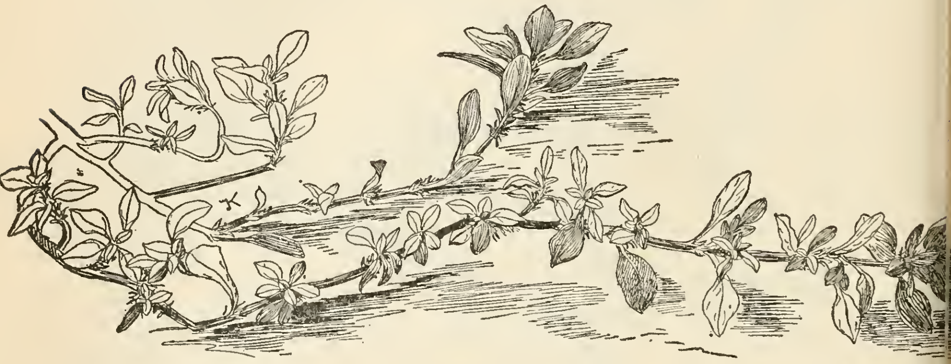

Fig. 208. Prostrate Pigweed (*Amaranthus blitoides*). A common weed. May cause bloat. (Charlotte M. King.)

Distribution. Species naturalized from tropical America but rare or local in places; common southward.

Amaranthus spinosus L. Spiny Amaranth

Stout, branched stem, leaves ovate, rhombic-ovate or lanceolate, acute at both ends with a pair of rigid stipular spines; sepals mucronate-tipped 1-nerved; utricle scarcely circumscissile.

Distribution. In waste or cultivated ground as far north as Massachusetts, Illinois and common in Missouri and Southward. Naturalized from tropical America.

Poisonous properties. The spiny amaranth sometimes produces mechanical injuries. Mr. O'Gara calls attention to the injurious properties of the first species in Nebraska. He says that it doubtless causes a great deal of trouble in some parts of that state. Mr. C. C. Palmer near North Platte lost 5 head of cattle in his pasture. In all cases they were very much bloated and a post-mortem examination revealed a good deal of pig-weed in the stomachs. The animals in question had been accustomed to prairie grass pasture and broke into a field containing considerable of this pig-weed, some Russian Thistle and

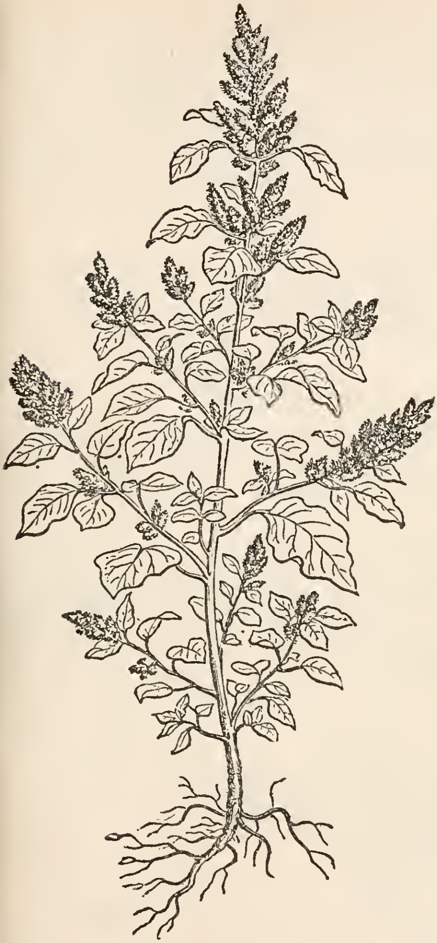

Fig. 209. Pigweed (*Amaranthus retroflexus*). A cause of bloat in cattle. (From Darlington's Weeds and Useful Planfs.)

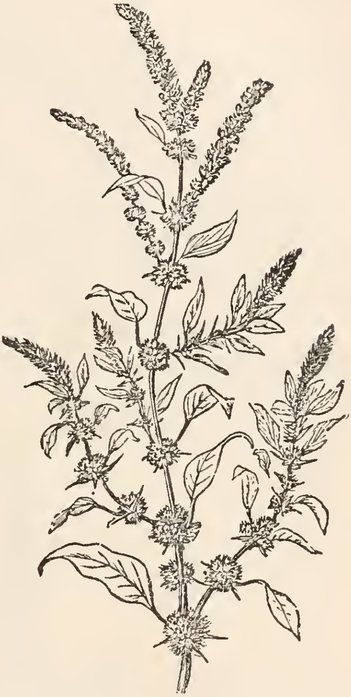

Fig. 210. Spiny Araranth (*Amaranthus spinosus*). Sometimes produces mechanical injuries. (From Darlington's Weeds and Useful Plants.)

lamb's quarter. After the death of the animals the fence was replaced and no further trouble was noticed. An experiment with animals carried on by Mr. O'Gara proved negative. Many families in the vicinity of North Platte regard the weed as a bad bloater, by some considered as serious as green clover and alfalfa.

PHYTOLACCACEAE. Pokeweed Family

Generally herbs, a few tropical species, trees or shrubs; leaves alternate, entire, without stipules; flowers regular, perfect, polygamous or monoecious; calyx petal-like, of 4 or 5 sepals, or 4-5-parted; stamens 5-30 alternate with the segments of the calyx or with the sepals, of the same number or more numerous; ovary several-celled; ovules solitary.

A small family of about 85 species, mostly tropical. The juice of the berries of the Umbra tree (*Phytolacca dioica*) of South America, now naturalized in Europe and other warm countries, is used to color wines. Other plants of the family, like bloodberry are frequently cultivated. The latter produces small spikes of white flowers, followed by red berries. Strong drastic substances occur in *P. littoralis* and *Anisomeria drastica,* natives of Chili. *P. abyssinica, Villamilla peruviana* and our native pokeberry contain *saponin* and red coloring matter.

Phytolacca (Tourn.) L. Pokeweed

Tall, stout, perennial herbs with large petioled leaves; flowers borne in racemes; calyx of 5 petal-like sepals; stamens 5-30, ovary of 5-12 carpels united to form a ring, 5-12 celled, with a single seed in each cell; embryo around the endosperm.

Phytolacca decandra L. Pokeweed, Garget

A tall, glabrous, perennial herb, 6-9 feet tall, with strong odor; large poisonous root; leaves oblong-lanceolate, acute, or acuminate; flowers perfect; calyx white; stamens 10, shorter than the sepals; ovary green, 10-celled; berry dark purple, filled with crimson juice.

Poisonous properties. The young shoots of this plant may be boiled and eaten, the acrid property being dissipated in boiling. The leaves are eaten by the natives of the island of Guam. A tincture of the plant is used for rheumatism. The root is alterative, emetic, cathartic, and narcotic. Prof. Chesnut, in speaking of its poisonous nature, says:

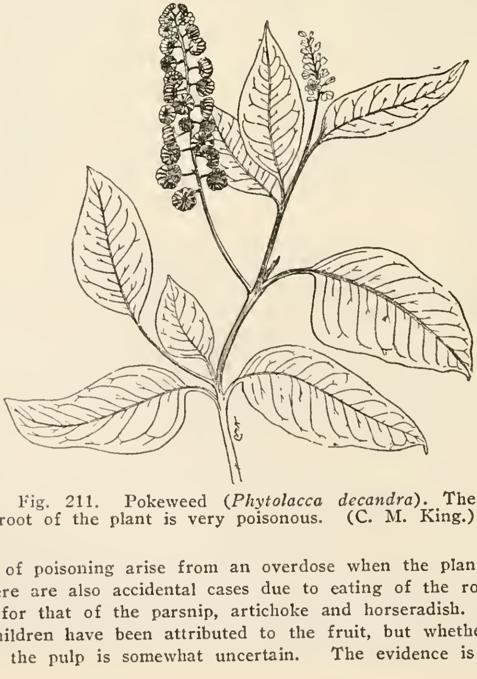

Fig. 211. Pokeweed (*Phytolacca decandra*). The root of the plant is very poisonous. (C. M. King.)

Most instances of poisoning arise from an overdose when the plant has been used as a medicine, but there are also accidental cases due to eating of the root, which has been variously mistaken for that of the parsnip, artichoke and horseradish. A few fatal cases of poisonoing of children have been attributed to the fruit, but whether death was really due to the seed or the pulp is somewhat uncertain. The evidence is chiefly against the seed, for it is known to contain a poisonous substance. Pokeweed is a violent but slow-acting emetic, vomiting beginning only after about two hours. It also effects the nerves and muscles, producing retching, spasms, severe purging and sometimes convulsions. Death is frequently due to the paralysis of the respiratory organs.

Dr. Guttenberg makes a similar report in regard to effects of poisoning by pokeweed, adding that death often is a result.

The roots of pokeweed are often mistaken for other fleshy roots, such as horse-radish. The leaves, as has been said, are harmless when boiled, somewhat resembling spinach, but the root is very poisonous. The poke root was used by the Indians in medecine. Dr. Millspaugh, who values the plant not only as an emetic, but also as an efficient remedy, says:

> In certain forms of rheumatism, the root with lard was found to be an excellent ointment as a cure for many forms of skin diseases; psoriasis, eczema, capitis, and tinea circinata, also in syphilitic ulcers.

Dr. Millspaugh says:

> The fresh root, gathered late in autumn or early in spring, is chopped and pounded to a pulp and weighed. Two parts by weight of alcohol are taken, and after thoroughly mixing the pulp with one-sixth part of it, the rest of the alcohol is added. After having stirred the whole, pour it into a well-stoppered bottle, and let it stand eight days in a dark, cool place. The tincture is then separated by decanting, straining, and filtering.
>
> Thus prepared it has a light straw-color by transmitted light, at first a stinging, soon followed by a decided bitter taste, and a very slight acid reaction.

He adds:

> I noted in my readings several years ago that the berries had been used for pies by frugal housewives, and often since have half determined to try poke-berry pastry; discretion has, however, always overruled valor, and the much-thought-of pie is still unmade and uneaten. The young shoots, however, make an excellent substitute for asparagus, and I much prefer them, if gathered early and discriminately.

The acrid alkaloid *phytolaccin,* according to Dr. Edmond Preston, occurs in the root of this plant; also *phytolaccic acid* and an amorphous yellowish brown, transparent substance, very soluble in water and alcohol. Nagi reports a toxic substance *phytolaccotoxin* $C_{24}H_{38}O_8$. The berries have been used for coloring, but this is not entirely successful, because no mordant will fix the color. The juice of the berry is a delicate test for acids when lime water is added to it.

Dr. Johnson says:

> All parts of the plant possess acrid and somewhat narcotic properties. The juice of the fresh plant, or a strong decoction of the root, applied locally, may strongly irritate the skin, especially if tender or abraded. Taken internally it causes nausea, vomiting, and purging, and, in overdoses, acro-narcotic poisoning. It has been employed with more or less satisfactory results in a great variety of cutaneous affections, and in rheumatism, especially when chronic or of a syphilitic origin. There is little doubt that, in view of the uncertainty which at present exists regarding it, this plant would well repay further careful experimentation.

Nagi reports that *phytolaccotoxin* resembles *picrotoxin* and *cicutoxin.* A glucoside has also been found in common poke; saponin also occurs.

CARYOPHYLLACEAE. Pink Family

Herbs with opposite entire leaves, frequently swollen at the nodes; flowers perfect or rarely dioecious; sepals 4 or 5, persistent separate or united with the calyx tube; petals of equal number; styles 2-5, or rarely united into 1; ovary usually 1-celled, occasionally 3-5-celled; ovules attached to a central column; seeds several or many; small coiled or curved embryo, with a mealy albumen.

A large family of about 70 genera and 1500 species, widely distributed, most abundant in the northern hemisphere. Many of the plants of this family

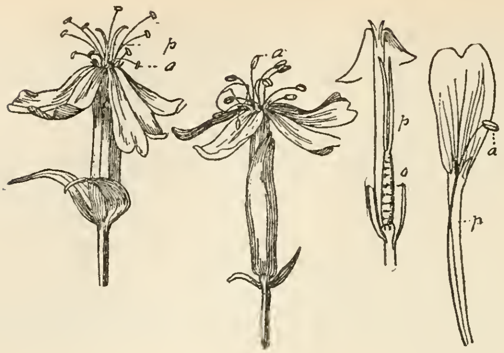

Fig. 211a.

Fig. 211a. Flowers of Soapwort or Bouncing Betty (*Saponaria officinalis*), Calyx, Corolla, Stamens and Pistil. (C. M. King).

are cultivated for ornamental purposes. Of these we may mention the hardy pink (*Dianthus barbatus*) and carnation (*D. Caryophyllus*). The spurrey (*Spergula arvensis*) is occasionally cultivated as a forage plant in Europe and sometimes in this country, but is a weed of grain fields in Europe. A few species like *Saponaria officinalis* and the catchfly are medicinal. A red dye is obtained from a species of Coccus found on *Scleranthus perennis*. The leaves of *Paronychia argentea* are used as a substitute for tea. The stitchwort (*Alsine crassifolia*) of Europe and some parts of the United States is poisonous to horses. The European sandwort (*Arenaria serpyllifolia*) common eastward in sandy waste places is said to cause salivation in horses. Several species of the family like *Saponaria officinalis, Gypsophila Struthium* of Spain, *Agrostemma, Lychnis,* and *Herniaria* contain *saponin.*

Genera of *Caryophyllaceae*

- Sepals united into a tube or cup.
  - Calyx ovoid or sub-cylindrical, 5 angled; not prominently nerved. .5. Saponaria.
    - Calyx 5-toothed, prominently nerved.
      - Styles 3..2. Silene.
      - Styles 5 or 4, alternate with petals......................3. Lychnis.
      - Styles 5 or 4, opposite petals, silky plants..........4. Agrostemma.
      - Styles 2 ....1. Gypsophila.
- Sepals distinct ....6. Stellaria.

1. *Gypsophila* L. Gypsophyl

Glabrous and glaucous herbs; leaves narrow; flowers small, in paniculate, axillary clusters; calyx cylindrical, 5-toothed, 5-nerved without bractlets; petals 5 claws, narrow; stamens 10; styles 2. About 50 species native to Europe; 2 species introduced to North America.

Gypsophila paniculata L. Tall Gypsophyl

A glabrous or pubescent perennial, from a simple fusiform root; leaves lanceolate, narrowed at the base; flowers in panicled cymes; calyx campanulate;

segments with scarious margins; petals white or pink, slightly emarginate, larger than the calyx.

Distribution. Native to Europe and Asia. From Manitoba to Nebraska.

Poisonous properties. Used in medicine as a detergent. An allied *G. Struthium* contains *Sapotoxin* and the glucoside *saponin.* It is an acrid poison.

2. *Silene* L. Catchfly

Herbs with pink or white flowers, solitary or borne in cymes; calyx more or less inflated and five-toothed; petals 5, narrow and clawed; stamens 10; styles 3, rarely 4 or 5; ovary 1-celled or incompletely 2- to 4-celled; pod 1-celled, dehiscent by 6, apical teeth; seeds roughened.

About 250 species of wide distribution. Several like sweet William (*S. Armeria*) are cultivated for ornamental purposes. The starry campion (*S. stellata*) of our prairies and thickets might well be cultivated more than it is.

Silene latifolia (Mill.) Britten & Rendle. Bladder Campion

A branched perennial, a foot or more high, with opposite glaucus ovate lanceolate leaves; flowers in loose cymose panicles; calyx bladdery, inflated; petals 2-cleft, white; seed roughened.

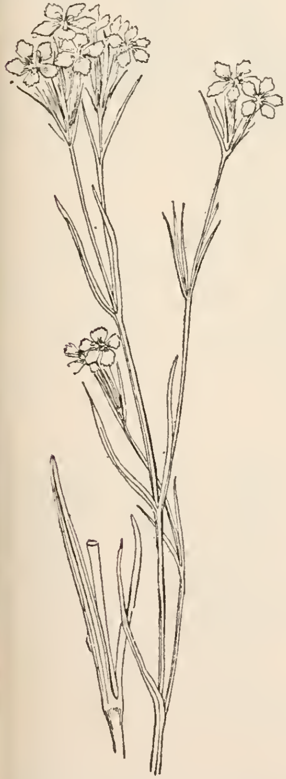

Fig. 212. Deptford Pink (*Dianthus Armeria*). Frequently cultivated for ornamental purpose. (Charlotte M. King.)

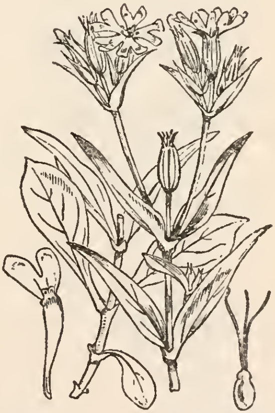

Fig. 213. Night flowering Catchfly (*Silene noctiflora*). (After Fitch.)

Distribution. Native to Europe. Common in fields and along roadsides from New England to Illinois and Iowa.

Silene antirrhina L. Sleepy Catchfly

A puberulent annual with glutinous nodes and slender stem; lower leaves spatulate or oblanceolate, petioled; upper leaves linear to subulate; flowers small in cymose panicles; calyx not inflated, but expanded by the opening pod, ovoid; petals pink, obcordate, minutely crowned, seeds small, roughened.

Distribution. Common in sandy fields, gravelly soils, and in waste places from New England and Florida to Mexico, north to British Columbia, and east to Ontario.

Silene noctiflora L. Night-flowering Catchfly

A viscid hairy annual, from 1-3 feet high; lower leaves obovate or oblanceolate; the upper sessile and lanceolate; flowers few, in a loose panicle, white or

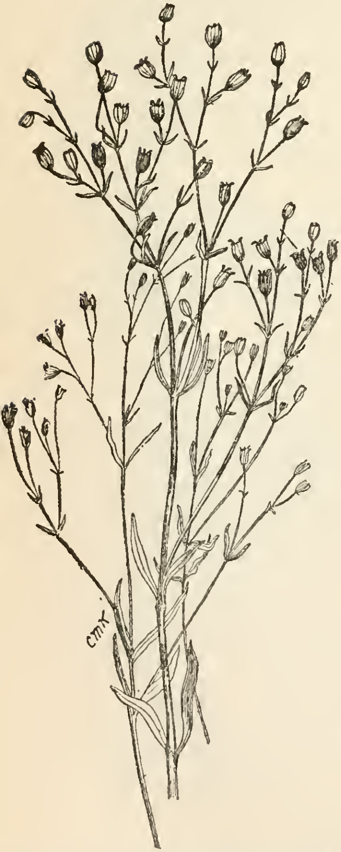

Fig. 214. Sleepy Catchfly (*Silene antirrhina*). A weed of sandy fields. (Charlotte M. King.)

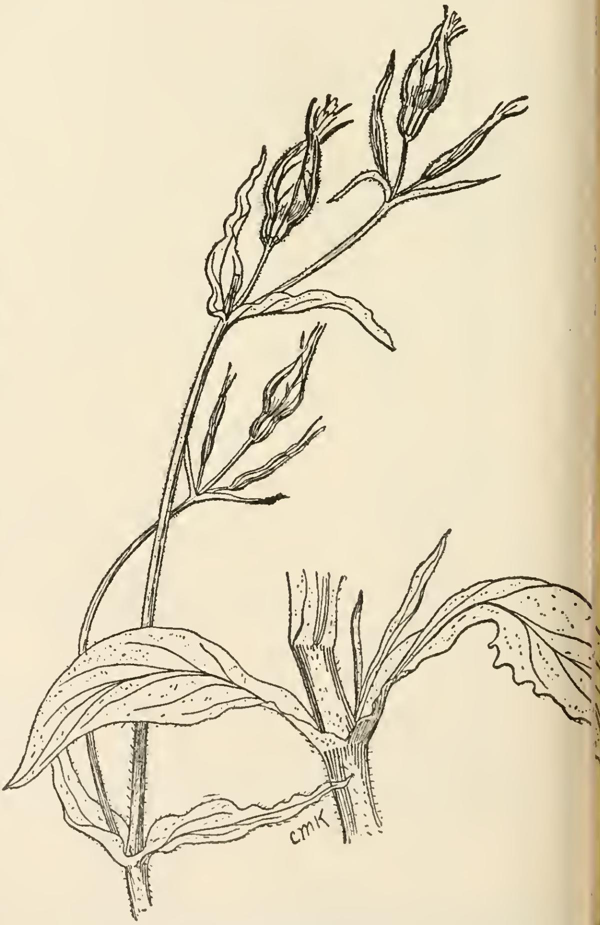

Fig. 215. Night-flowering Catchfly (*Silene noctiflora*). poisonous. (Charlotte M. King.)

pinkish, fragrant, opening at night, calyx tube elongated and enlarged by the ripening pod; petals 2-cleft and crowned; seeds small blackish, roughened, kidney shaped.

Distribution. Native to Europe. Common in waste places from New Brunswick to Florida, Kansas and Iowa to Manitoba.

Poisonous properties. According to Stebler and Schröter, the leaves of *Silene latifolia* are eaten by stock and it is regarded as of some value for forage purposes; but Prof. Schaffner, in his "Poisonous and Other Injurious Plants of Ohio," suggests that the sleepy catchfly may be poisonous.

3. *Lychnis* (*Tourn.*) L. Campion

Erect herbs, with ovoid tubular oblong or inflated calyx 5-toothed, 10-nerved, occasionally with leaf-like lobes; petals 5, or rarely 4; styles 5, rarely 4, alternate with the often appendaged petals; seeds numerous, globular or kidney-shaped pod opening by as many, or twice as many valves. A small genus of about 40 species native to the cooler regious. Several species cultivated for ornamental purposes. The scarlet lychnis (*L. chalcedonica*) is frequently cultivated in old gardens.

Lychnis Flos-cuculi L. Ragged robin

A downy, branching, pubescent annual, or viscid above, from 2-3 feet high; leaves lanceolate or linear lanceolate; flowers in loose panicles, red, bluish, or whitish; calyx glabrous, short, petals cleft into 4 lobes; capsule globose.

Poisonous properties. It contains a form of *saponin* called *lychnidin.*

Lychnis dioica L. Evening Lychnis

Biennial, usually dioecious, viscid, pubescent; leaves ovate-oblong or ovate-lanceolate; flowers few, loosely paniculate, white or pinkish, opening at evening; calyx tubular, becoming swollen with the ripening fruit; styles 5.

Distribution. Native to Europe, common in eastern and middle states. In the West it is not uncommon in clover fields, where it is introduced with clover seed.

4. *Agrostemma* Linn. Corn Cockle

Calyx ovoid, 10-ribbed; teeth elongated, longer than petals; stamens 10; styles 5, opposite unappendaged petals; leaves linear. Tall annual or biennial plant.

Agrostemma Githago L. Corn Cockle

A hairy annual weed; leaves linear-lanceolate, acute or long-acuminate; flowers perfect, long-peduncled, calyx lobes long, linear, surpassing the purple red petals, capsules 1-celled; large with numerous large seeds which are roughened and black.

Distribution. This plant is widely distributed from Nova Scotia to Quebec, south from New England to the southern states, and westward and northward, generally in wheat growing regions. Difficulty in screening wheat by ordinary methods has caused this weed to be generally scattered in wheat growing regions. These screenings are much used in feeding stock in some places. The farmer often sows cockle with his wheat.

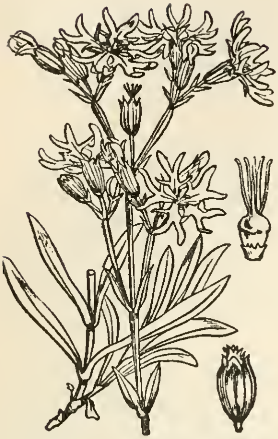

Fig. 216. Meadow Lychnis (*Lychnis Flos-cuculi*). Contains *saponin*. (After Fitch.)

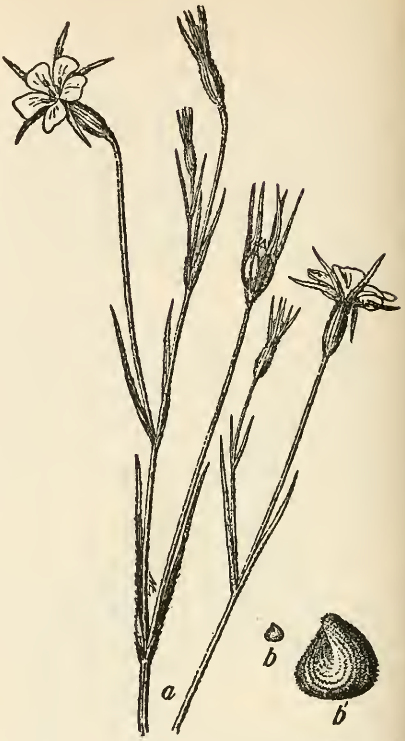

Fig. 217. Corn cockle (*Agrostemma Githago*). *a*, sprays showing flowers and seed capsule, one-third natural size; *b*, seed, natural size; *b′*, seed, four times natural size. (U. S. Dept. Agr.)

Poisonous properties. According to Kruskal, the seeds contain *githagin* $2(C_{17}H_{28}O_{11})$. The ripe dried seeds are broken into a coarse powder and used in medicine. Dr. Millspaugh gives the proportions as follows: "Five parts by weight of alcohol are poured upon the powder, and the whole allowed to stand eight days in a well stoppered bottle in a dark cool place, shaking thoroughly twice a day." The tincture is somewhat acrid. The seeds of the cockle are frequently used to adulterate cheaper grades of flour in Europe. Dr. Millspaugh gives a case in which death followed where two 14½ oz. lots of wheat flour containing respectively 30% and 45% of these seeds were fed to two calves. This amount of cockle caused severe cramps of the stomach within an hour, followed by diarrhoea and finally death. Where ducks and geese ate the seeds, death followed when sufficient was taken, and the post-mortem showed inflammation of the bowels. Prof. Pierce states that this is especially true when the seeds are crushed. A large amount of screenings are sold for chicken feed, and frequently complaints are made of poison, or at least that chickens will not eat the screenings.

In describing symptoms indicative of poisoning by corn cockle, which, Dr. Allen says, place the seeds among the cerebro-spinal irritants, he agrees essentially with Dr. Chesnut.

Dr. Chesnut says:

> The poisonous constituent, *saponin*, is a non-crystalline powder, very freely soluble in water, and possessing a sharp, burning taste. It has no odor, but when inhaled in the smallest quantity it produces violent sneezing. When briskly shaken with water it froths like soap. The poison is found in nearly all parts of the plant, but mainly in the kernel of the seed. Cases of poisoning have been noted among all sorts of poultry and household animals, but are rarely due to any portion of the plant as found growing in the field. The poisoning is generally produced by a poor grade of flour made from wheat containing cockle seeds. Machinery is used to remove these seeds from the wheat, but the difficulty of separating them is so great that the result is not entirely accomplished. The quantity remaining determines the grade of flour in this particular regard. It sometimes amounts to 30 or 40 per cent, but this quality is sent out only by ignorant or unscrupulous dealers or is intended for consumption by animals only. Flour containing a smaller amount has often been made into bread and eaten, sometimes with fatal results, the baking not always being sufficient to decompose the poison. The effect may be acute, or, if a small quantity of the meal is eaten regularly, it may be chronic. In the latter case it is sometimes known as a disease under the name of "githagism." The general symptoms of acute poisoning are the following: Intense irritation of the whole digestive tract, vomiting, headache, nausea, diarrhoea, hot skin, difficult locomotion, and depressed breathing. Coma is sometimes present, and may be followed by death. Chronic poisoning has not been closely studied in man, but experiments upon animals show chronic diarrhoea and gradual depression, the animal losing vigor in breathing and in muscular movements until death ensues. The action is antagonized by the use of digitalin, or of the simple extract of digitalis (*Digitalis purpurea*) a dangerous poison, which should be given only by a physician.

The more prominent symptoms as recorded by Friedberger and Fröhner are, briefly, colic, vomiting, slavering, paralysis, stupor, hyperaemia of brain and spinal cord.

Dr. Chesnut also adds:

> Corn cockle meal is easily detected in second and third class flour by the presence of the black, roughened scales of the seed coat. These are sure to occur if the flour has not been well bolted. Its presence is otherwise detected by the peculiar odor produced when the meal is moistened and by chemical tests with iodine. Wheat containing corn cockle seeds should be rejected for planting.

It has been asserted in Europe that corn cockle is injurious in flour and bread stuffs. Dr. Chesnut says:

> A person eating 1200 grains of bread made from flour containing only one-half per cent of corn cockle seed would consume six grains of cockle seed, an amount which the author believes beyond a doubt to be poisonous in its effects.

The poison in corn cockle is *sapotoxin* $C_{17}H_{26}O_{10}$ and is partially decomposed while baking, but nevertheless some of it remains and the use of flour which contains corn cockle should be forbidden. It has long been suspected of being poisonous. Mr. John Smith in his Domestic Botany, says:

> It being difficult to separate the seeds from the grain, the value of the latter is deteriorated, and the flour is rendered unwholesome.

5. *Saponaria* Linn. Soapwort

Calyx ovoid to sub-cylindrical, 5-toothed, obscurely nerved, terete or 5-angled, smooth; stamens 10; styles 2; pod 1-celled, or sometimes 2-4-valved, and 4-toothed to apex. Coarse annual or perennial with mucilaginous juice, hence common name of soapwort because of the property of forming a lather with water.

Saponaria officinalis L. Bouncing Bet

Perennial herbs with large flowers in cymose clusters; calyx narrowly ovoid or oblong, five toothed; petals clawed or unappendaged, stamens 10, styles 2, pod 1-celled or incompletely 2 to 4-celled and 4-toothed at the apex. About

40 species in Europe, Asia, and Northern Africa. *Saponaria officinalis* is frequently cultivated in old gardens. The mucilaginous juice forms a lather with water and is valuable for taking grease spots out of wollen cloth.

Saponaria Vaccaria L. Cow herb

A glabrous annual from 1-2 feet high with opposite ovate lanceolate leaves; flowers in corymbed cymes; calyx 5-angled, enlarged and angled in fruit; petals pale red. Cow herb is another important constituent of "cockle" in wheat screenings, and like the preceding weed has been largely spread by means of wheat culture.

Distribution. Common in Europe; found in wheat fields of the east and as far west as Missouri, Kansas, the Rocky Mountain region, and Pacific Coast, and wheat regions of the northwest.

According to Sohn, it contains the substance *saponin*, $C_{22}H_{54}O_{18}$ a neutral sharp, amorphous substance, having a burning taste and producing a violent sensation. The toxic substance is partially removed by baking.

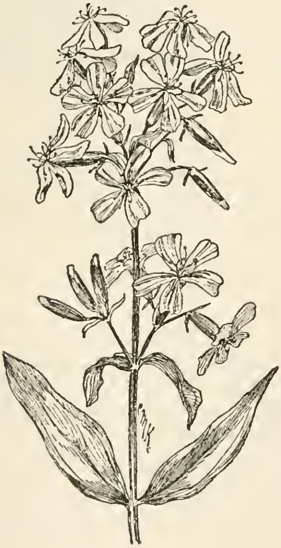

Fig. 218. Bouncing Betty (*Saponaria officinalis*). A branch with flowers. The double flowered form is sometimes cultivated for ornamental purposes. (Charlotte M. King.)

6. *Stellaria* L. Chickweed

Tufted herbs with white flowers in cymose clusters; sepals 4-5, deeply 2-cleft, sometimes none; stamens free, 10 or fewer; styles 3, rarely 4 or 5; capsule ovoid 1-celled, several to many seeded.

Stellaria media (L.) Cyrill. Common Chickweed

A nearly smooth annual or winter annual, decumbent or ascending; leaves ovate or oval, the lower on hairy petioles; flowers white in terminal leafy cymes or solitary in the axils; sepals oblong, longer than the 2-parted petals; stamens 2-10.

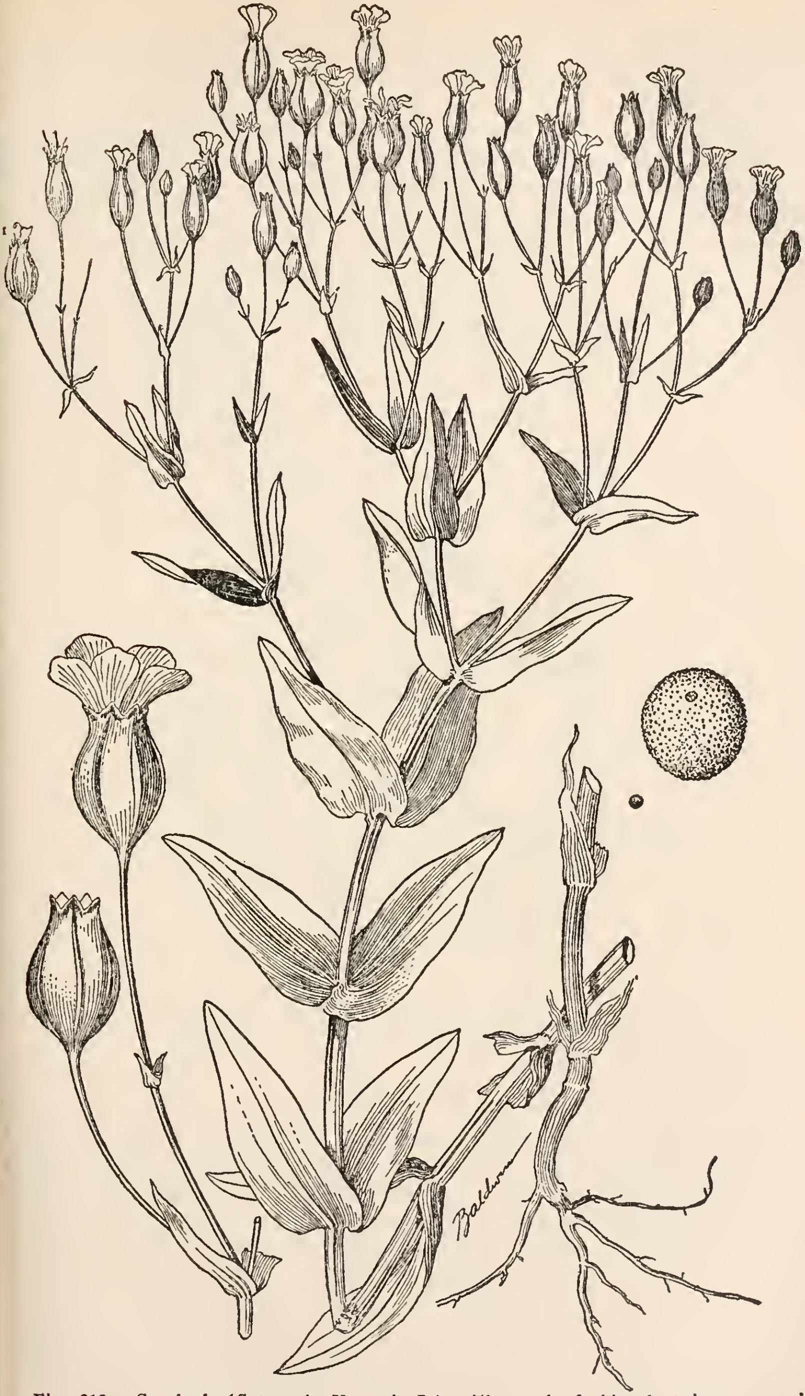

Fig. 219. Cow-herb (*Saponaria Vaccaria* L.). The seed of this plant is common in vheat screenings and is supposed to be poisonous. (U. S. Dept. Agrl.)

Distribution. A weed in waste places, lawns and fields, very troublesome in lawns. Naturalized from Europe. Extends from New England and Canada across the continent.

Poisonous properties. The seeds of common chickweed are used as food for cage-birds and are also readily eaten by chickens, but, according to Mr. Wm. Carruthers, they cause disorder to the digestive system when eaten by lambs in large quantities.

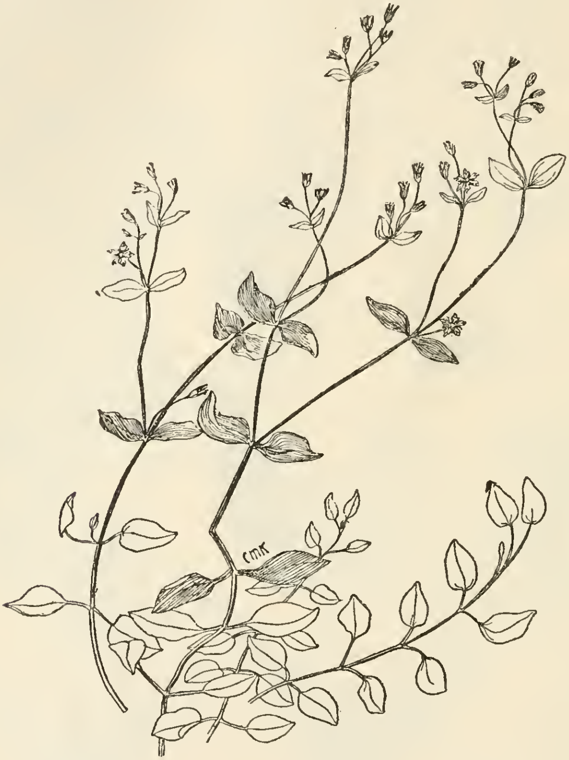

Fig. 220. Chickweed (*Stellaria media*). Seeds said to be injurious. (Charlotte M. King.)

RANALES

Herbs, shrubs or trees; calyx usually of separate sepals; corolla usually present and of separate petals; ovary or ovaries superior, free from the calyx; carpels 1-many; stamens mostly hypogynous and more numerous than the sepals. Contains the families *Nymphaeaceae, Ceratophyllaceae, Ranunculaceae, Berberidaceae, Menispermaceae, Magnoliaceae, Calycanthaceae, Anonaceae, Myristicaceae,* and *Lauraceae.* The *Nymphaeaceae* are aquatic perennial herbs. The rhizome of water chinquapin (*Nelumbo lutea*) of the Mississippi Valley and introduced into Massachusetts by the Indians, was used for food. The sacred bean or lily (*N. nucifera*) cultivated for ornamental purposes produces an edible seed and rhizome rich in starch. The pods of wokas (*Nymphaea polysepala*) are used as food by the Indians in the northwest. The blue flowered *Nymphaea stellata* of tropical Africa and the Egyptian lotus (*N. Lotus*) are frequently cultivated, as are the *Victoria regia* of the Amazon region and *Euryale ferox* of eastern Asia. The water lilies (*Castalia odorata* and *C. tuberosa*) are pretty water plants of North America. The family *Ceratophyllaceae* contains the water-weed (*Ceratophyllum demersum*) of North America, troublesome also in Europe. The family *Myristicaceae* contains the nutmeg (*Myristica fragrans*) of which mace is the aril; the oil contains *myristicin.* Prof. Cushny in an address before the Royal Society of Medicine in London, referring to Nutmeg poisoning, says that the symptoms are drowsiness, stupor, and diplopia ('seeing double'). Delirium is frequently present, and sometimes the first symptom is burning pain in the stomach, with anxiety or giddiness. The symptoms generally resemble those resulting from *Cannabis indica* (hashish). One fatal case occurred in a boy who had eaten two nutmegs. From experimental work Prof. Cushny has come to the conclusion that the symptoms are to be attributed to the action of the oil of nutmeg on the central nervous system. This is depressed; but there are some signs of stimulation in the form of restlessness, slight convulsive movements, and tremor. The oil has also a marked local irritant action, whether given by the mouth or hypodermically. Several other species like *M. succedanea* and *M. fatua,* are used by the natives where these plants are indigenous.

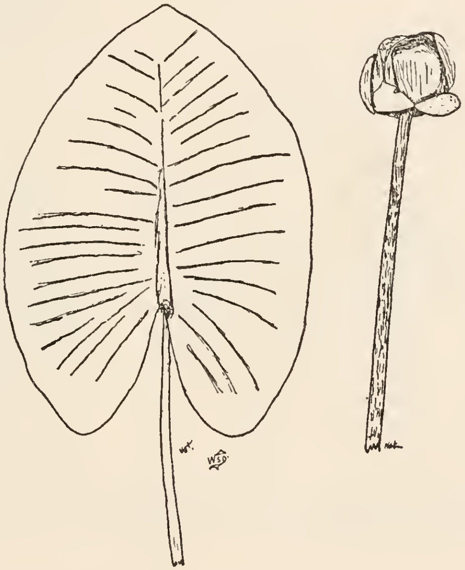

Fig. 221. Yellow Water Lily (*Nymphaea polysepala*). (W. S. Dudgeon.)

Families of Ranales

Stamens numerous sepals distinct, petals absent or present.
  Receptacle hollow enclosing the numerous pistils and achenes; leaves opposite..5 Calycanthaceae

Receptacle not hollow; flowers generally perfect.
Fruits cohering over each other, cone-like..............Magnoliaceae
Fruits not cohering over each other, separate.
Anthers not opening by uplifted valves, pistils usually more than 1.
Sepals 3; petals 6; shrubs or trees................Anonaceae
Sepals 3-15; petals when present about as many..Ranunculaceae
Anthers opening by uplifted valves except Podophyllum; pistil 1 ....Berberidaceae
Dioecious climbing vines; simple leaves........Menispermaceae
Stamens 9-12 in several series; anthers opening by uplifted valves; petals absent. ....Lauraceae

RANUNCULACEAE. Crowfoot Family

Herbs or a few woody plants with acrid juice; flowers polypetalous or apetalous, regular or irregular; calyx free, often colored like the corolla; sepals 3-15; petals 3-15 or absent,stamens numerous; pistils few or numerous, distinct; fruit a dry pod, berries or achene seed-like; embryo minute, albumen present.

A rather large, widely distributed family of plants many of which like aconite, larkspur, and marsh marigold, are poisonous. Many, such as virgin's bower (*Clematis virginiana*), *C. Jackmanni* and other species, are cultivated for ornamental purposes; the *C. Jackmanni* being especially desirable. The columbines, like the European columbine (*Aquilegia vulgaris*), the Rocky Mountain columbine (*A. caerulea*), and our eastern columbine *A. canadensis*), the paeonies (*Paeonia officinalis* and *P. Moutan*), and the larkspurs (*Delphinium*) are also cultivated for ornamental purposes, the most familiar of the latter being the garden annual, *Delphinium Consolida.* Several perennial species of *Delphinium* are also very showy. The seeds of stavesacre (*D. Staphisagria*), native to southern Europe and the Levant, contain an alkaloid *delphinin* $C_{22}H_{35}NO_6$ which is a powerful and acrid poison.

Nigella is said to contain an alkaloid, *nigellin; N. damascena* contains the alkaloid *damascenin* $C_9H_{11}NO_3$. In 1872, a German chemist found an alkaloid in *Isopyrum thalictroides,* the so-called *isopyrin* $C_{28}H_{11}NO_3$. *Thalictrum macrocarpum* contains the alkaloid *thalictrin.* *Aquilegia* is said to be free from alkaloids.

Glucosides have also been found in some of the members of this family, as *adonidin* $C_{40}H_{40}O_9$ in *Adonis amurensis.*

The European *Adonis aestivalis* and *A. vernalis* are recorded as poisonous by Lehmann. The black cohosh (*Cimicifuga racemosa*) is also somewhat acrid.

Many of the plants of the family contain *anemonin* $C_{10}H_8O_4$ and some are used for medicinal purposes.

Among these are aconite (*Aconitum Napellus*), crocus, Pasque flower, pulsatilla *Anemone patens* var. *Wolfgangiana* (Bess) Koch. and yellow puccoon (*Hydrastis canadensis*). The black roots of black hellebore (*Helleborus niger*) are used in medicine, as a purgative, being poisonous in overdoses. The tuberous roots of one of the crowfoots (*Ranunculus Ficaria*) resemble grains of wheat and are sometimes boiled and eaten but they have a sharp acrid taste and are known to produce blisters. The water crowfoot (*R. aquatilis* var. *capillaceus*) is apparently harmless and is used as forage in England and on the Continent.

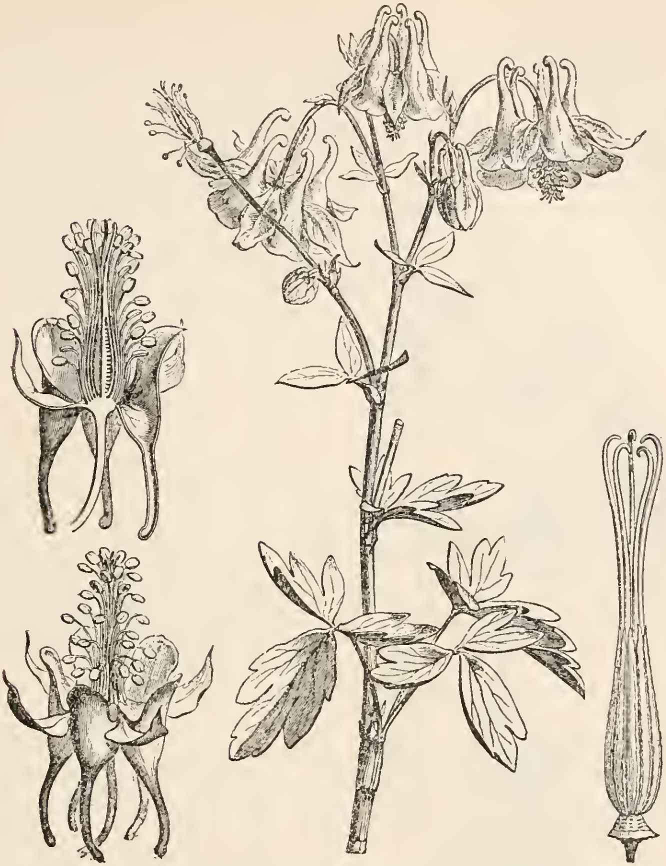

Fig. 222. European Columbine (*Aquilegia vulgaris*). Flowering branch; flower; longitudinal section of flower; pistil and stamens. (After Faguet.)

According to Greshoff *Clematis Fremonti; C. integrifolia; C. lanuginosa; C. orientalis; C. pseudo-flammula* contain HCN. He also states that saponin is of widespread occurrence in this genus and that he found it in the leaves of *C. Pitcheri,* and *C. recta* and in the leaves of *Trollius pumilus,* and *T. chinensis.*

Genera of Ranunculaceae

Flowers regular.
Sepals 3-20 apetalous.
Achenes tailed ....5 Clematis
Achenes not tailed ....4 Anemone
Fruit a follicle; sepals yellow.............................1 Caltha
Flowers solitary; sepals 3..................................9 Hydrastis
Petals and sepals present.
Petals 5, yellow or white ....6 Ranunculus
Petals small, tubular 2-lipped..............................2 Helleborus
Petals small, stamen-like.......................................8 Actaea

Flowers irregular.
  Upper sepal spurred; petals 4.............................7 Delphinium
  Upper sepal hooded...3 Aconitum

1. Caltha L. Marsh Marigold

Herbs with heart-shaped or kidney-form leaves; flowers yellow, white or pink; sepals large, 5-9, petal-like; petals none; stamens numerous; pistils 5-10; styles nearly wanting; pods follicles, spreading, many seeded; marsh plants of temperate and colder regions. About 8 species; 3 species native to Eastern North America, and 1 species common in the Rocky Mountains at high altitudes.

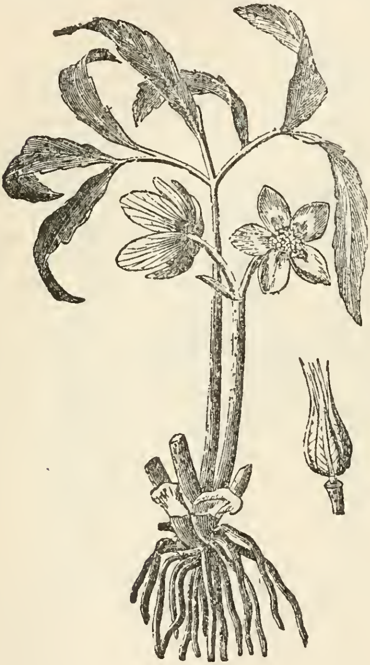

Fig. 223. Black Hellebore (*Helleborus niger*). Entire plant. The roots contain a purgative substance that is poisonous in over-doses. (From Vesque's Traité de Botanique.)

Caltha palustris L. Marsh Marigold

A stout, glabrous perennial with a hollow stem from 1-2 feet high; the basal leaves on long petioles, leaves reniform; upper leaves shorter, petioled and sessile; flowers with yellow sepals.

Occurs in swamps and meadows.

Poisonous properties. The marsh marigold or cowslip is regarded as poisonous in Europe. In this country, however, it is frequently used as a pot herb. The flower buds are sometimes pickled. Coville says:

> By many it is considered superior to any other plant used in this way. There is no doubt that boiling dissipates the active principles found in the plant.

Stebler and Schröter say that it is poisonous in a green state, and Rusby states that when fed with hay it produces diarrhoea and stoppage of the flow of milk. According to Lloyd, it contains a small quantity of an acrid substance identical with the acrid oil of *Ranunculus.* Cattle and sheep refuse to eat the plant. Marsh marigold is known to contain an alkaloid which is said to be identical with *nicotin* but it has not been isolated.

Dr. Millspaugh in speaking of the uses of this plant, states that it is extensively gathered in early spring and cooked for greens, making one of our most excellent pot-herbs. Rafinesque asserts that cattle browsing upon it die in consequence of an inflammation of the stomach produced by it. According to Freidberger and Fröhner it causes haematuria.

2. *Helleborus* L. Hellebore

Erect perennial herbs, with large, palmately divided leaves; flowers large, white, greenish or yellowish; sepals 5, petal-like; petals small, tubular; stamens numerous; carpels generally few; fruit several-seeded follicles. A small genus of about 10 species, natives of Europe and Western Asia.

Helleborus viridis L. Green Hellebore

Basal leaves smooth, consisting of 7-11 oblong, acute, sharply-serrate segments; flowers large.

Distribution. In waste places from Long Island to Penn. and W. Va.

Poisonous properties. Black Hellebore is said to be a drastic purgative when used for domestic animals. The plant contains the glucosides, *helleborin* $C_6H_{10}O$, which is a highly narcotic, powerful poison, *helleborein* $C_{37}H_{56}O_{18}$ which is slightly acid and *heleboretin* $C_{19}H_{30}O_5$.

The symptoms from poisoning are: Stupor followed by death with spasms. *H. foetidus* is also poisonous.

3. *Aconitum* L. Aconite

Perennial herbs with palmately lobed or divided leaves; flowers large, irregular, showy, paniculate or racemose; sepals 5, irregular, petal-like, the upper helmet-shaped or hooded, prolonged into a spur; petals 2, small, concealed under helmet, spurred, 3 lower absent or very minute; pistils 3-5 forming follicles, several seeded.

About 60 species. Native of the North Temperate regions. One species, the *A. Napellus,* used in medicine, is the source of aconite. One western species is poisonous to live stock.

None of the species of this genus is weedy in Eastern North America. The three species, *A. noveboracense Gray, A. uncinatum L.* and *A. reclinatum Gray*, occur in Eastern North America but are very local. None of these seems to be very poisonous, but the roots of *A. uncinatum* are bitter, even in a dry state. The exotic *A. Lycoctonum* and *A. Fischeri* are employed to kill wild animals.

Aconite is derived from the European *Aconitum Napellus* which produces not only poisonous stem and leaves, but also a very poisonous tuberous root which is from 2-4 inches long and sometimes an inch thick. The Indian aconite is obtained from *Aconitum ferox,* a plant growing from 3-6 feet high and bearing large dull-blue flowers; it is found in the Alpine regions of the Himalayas, and is used as an arrow poison. Among other equally poisonous species mentioned by Flückiger and Hanbury, is *A. uncinatum* growing in Eastern North America. They also state that the root of another species of *Aconitum, A. heterophyllum,* with large flowers of dull yellow, and purple, or blue, is poisonous. This root contains the chemical substance *atisin* $C_{22}H_{31}NO_3$, an intensely bitter alkaloid. The European aconite contains *aconitin* $C_{33}H\,NO_{12}$, *pseudo aconitin* $C_{36}H_{49}NO_{12}$, and *aconin* $H_{39}C_{26}NO_{11}$. The North American species *A. septentrionale* contains, according to Rosendal, the following alkaloids: *lappakonitin,* $C_{34}H_{48}N_2O_8$, a crystallized form; *septentrionalin* $C_{31}H_{48}N_2O_9$, and *synaktonin* $C_{36}H_{55}N_2O_{13}$.

Blyth who has collected records of poisoning in Europe by aconite states that there have been two cases of murder, seven suicidal, seventy-seven more or less accidental; six were from the action of the alkaloid, ten from the root, and in two cases, children ate the flower, in one case, the leaves of the plant were cooked and eaten by mistake, in seven cases, the tincture was mistaken for brandy, sherry or liquor, in the remainder of the cases the tincture, the liniment or the extract was used. The Indian species are much used, especially *A. ferox,* which is applied to poison stock and arrows, the latter to destroy the wild animals. It is a common practice to mix a decoction of the root with water or food.

Dunstan and Anderson * summarize the alkaloids obtained from Aconitum as follows:—"The first, a toxic group, of which the type is ordinary *aconitin,* contains alkaloids which are diacyl esters of a series of poly-hydric bases containing four methoxyl groups, the aconines."

"The members of this group are:—
Aconitin from *Aconitum napellus.*
Japaconitin from *Aconitum deinorrhysum.*
Bikhaconitin from *Aconitum spicatus.*
Indaconitin from *Aconitum chasmanthum.*"
These are all highly poisonous.

The second group is the atisin group which contains *atisin* from *A. heterophyllum* and *palmatin* from *A. palmatum.* These are non-poisonous alkaloids.

Aconitum columbianum Nutt. Western Aconite

An erect, stout perennial, 3-6 feet high, more or less pubescent above, with short, spreading or viscid hairs; divisions of the leaves broadly cuneate and toothed, lobed; flowers purple or white, in a loose terminal raceme; hood variable in breadth and length of beak.

Distribution. Grows at an altitude of 5000-10,000 feet in low grounds, near brooks and springs, from Montana, Wyoming and Colorado to the Sierras.

Poisonous properties. The chief effect of aconite results from its influence over the heart and blood vessels. It decreases the force and frequency of the cardiac pulsations. After long continued use, aconite affects the nervous system causing the loss of sensation; bodily temperature is also reduced after medicinal uses of the drug. Dr. Winslow, in his Veterinary Materia Medica and Therapeutics, speaking of its toxicology says:

> The minimum fatal dose of aconite is about 3i. for the horse; gr. xx. for medium sized dogs; and gr. v.-vi. for cats. The smallest fatal dose recorded in man is a teaspoonful of tincture of aconite, equivalent to about gr. xxx. of the crude drug. The minimum lethal quantity of aconitin is gr. 1/10 for man, and about the same for cats. For dogs it is from gr. ¼ to gr. ½. The writer has found that cats will live from fifteen minutes to half an hour after receiving the smaller deadly doses under the skin, but large doses produce death immediately by paralyzing the heart. Large therapeutic doses cause, in horses, restlessness, pawing the ground, shaking of the head, champing of the jaws, increased secretion of salivary mucus, and attempts at swallowing, probably owing to the peculiar sense of irritation

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*Trans. Jour. Chem. Soc. 1905: 1650. See Blyth Poisons: Their Effects and Detection.

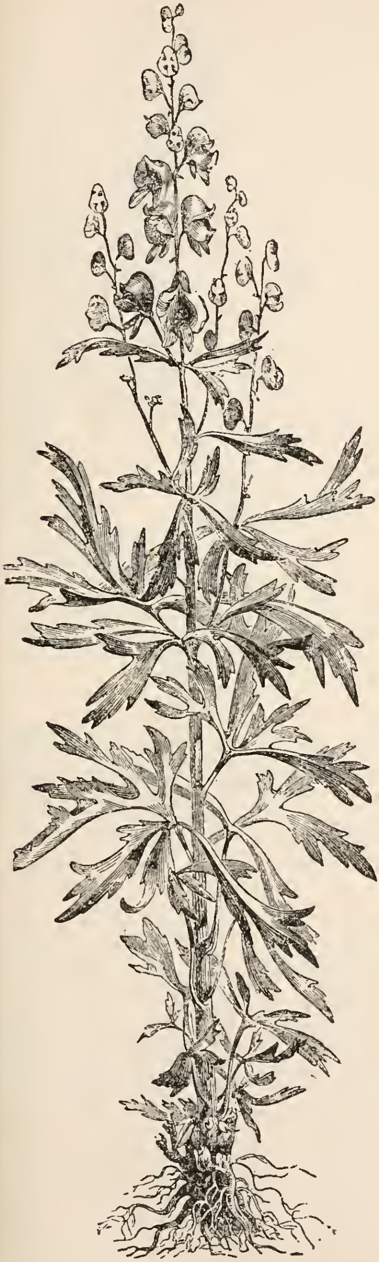

Fig. 224. Aconite (*Aconitum Napellus*). The source of the aconite of commerce. Stem, leaves and root are poisonous. (After Faguet.)

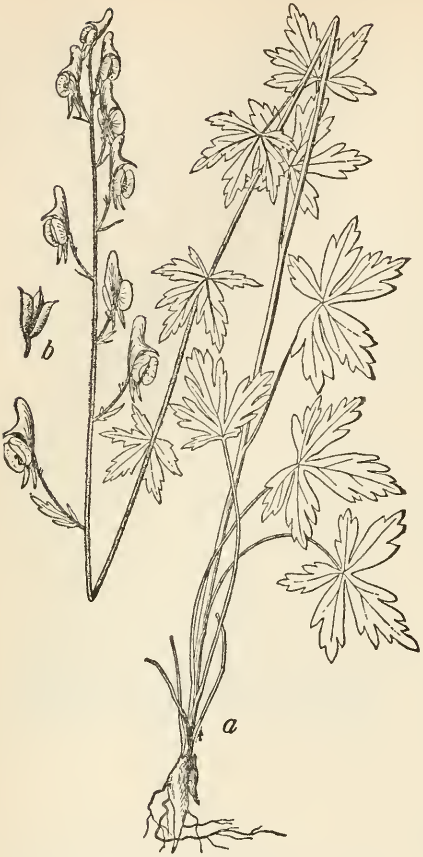

Fig. 225. Aconite (*Aconitum columbianum*). *a*, flowering plant; *b*, seed capsule—both one-third natural size. A poisonous plant of the Western U. S. (U. S. Dept. Agr.)

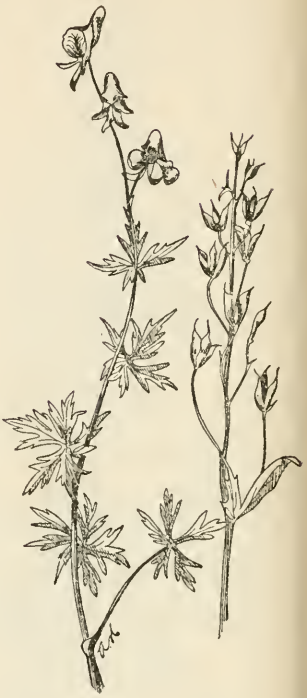

Fig. 226. Western aconite (*Aconitum uncinatum*). A poisonous plant in Eastern North America, from Pennsylvania to Iowa. (Ada Hayden.)

produced by the drug in the throat. Nausea and retching are observed in all animals, while vomiting occurs in dogs and cats. The pulse and respiration are weakened and generally retarded. After lethal doses these symptoms are intensified. We observe violent retching, frequent and difficult attacks of swallowing, ejection of frothy mucus from the mouth, in horses copious sweating; pulse first weak and infrequent, later rapid, running and almost imperceptible; respiration slow, interrupted, and shallow, and reduction of temperature. Death is preceded by muscular twitchings, in the horse, and loss of strength so that the subject falls and is unable to rise; or in the case of cats and rabbits, the animals jump vertically into the air, topple over backwards and go into convulsions, lying helpless on their side. The labial muscles are retracted and the lips drawn back, showing the teeth covered with foam. The face is anxious, the eyeballs are retracted or protruded, and the pupils more commonly dilated. Death takes place usually from asphyxia, occasionally from syncope. The post mortem appearances are simply those resulting from asphyxia.

The western aconite is bitter and retains its bitterness even on drying. It also benumbs, according to Lloyd, just as does the European aconite. The Lloyds quote Prof. Power in asserting that it contains some alkaloids, one probably *aconitin*, and several other poisonous principles. According to Dr.

Bartholow of Jefferson Medical College, it is a paralyzer of mobility, but does not impair the contractility of muscles or the irritability of the motor nerves. Death is caused by paralysis of respiration, the heart continuing its action some time after respiration has ceased. The *Aconitum Napellus*, affects the heart in opposite ways. Prof. Chesnut says in regard to the poison of this plant:

> All of the parts of the west American aconite are poisonous, but the seeds and roots are the most dangerous. The active principle is not well known, but chemical and physiological experiments point to the existence of one or more alkaloids which resemble aconitin. The effect of the poison is characteristic. There is first a tingling sensation on the end of the tongue which gives rise shortly to a burning sensation, and is rapidly followed by a very pronounced sense of constriction in the throat. The choking thus produced is made the more alarming by the retarding effect which the poison has upon the respiration. The tingling and prickling over the entire body is also characteristic. Besides these symptoms, there are generally severe headache, abdominal pains, confused vision, vomiting, and diarrhoea. Delirium is usually absent. Death ensues from a stoppage of the respiration in from one to eight hours.

Mr. R. Schimpfky, in his Important Poisonous Plants of Germany, makes this statement upon the authority of a physician: He tried the nectar of the European aconite by chewing the flower. After chewing a little while, the same was thrown away and an hour later, he felt upon the end of the tongue, a dull pain as though he had burned it. This sensation remained for three days. In Europe it is not unusual to mix the leaves of this with other salad plants. Frequently the plant is cultivated to be used in destroying insects.

Dr. Chesnut says:

> No specific antidote is recognized, but physicians have used atropin, or digitalis and nitrite of amyl, with good effects. The ordinary emetics and stimulants must be given. Artificial respiration should be maintained for a couple of hours, if necessary, and a recumbent position must be maintained throughout the treatment.

Aconitum uncinatum L. Wild Monkshood

Plant smooth; stem slender and somewhat reclined; root thickened; leaves 3-5 lobed, petioled, lobes ovate-lanceolate, with coarse teeth; large blue or pale flowers with erect helmet; found in rich shady woods along streams.

Distribution. Eastern North America extending into Iowa.

Poisonous properties. Contains the same active principle as the other species of aconite.

4. *Anemone*

Erect perennial herbs; root leaves lobed, divided or dissected; stem leaves forming an involucre either remote or near the flower; sepals few or many, 4-20 petal-like; or in one section, petals stamen-like; stamens numerous; pistils numerous; achene pointed or tailed, flattened; single seeded. About 80 species in temperate regions. Several as *Pulsatilla* are medicinal.

Anemone patens L. var. *Wolfgangiana* (Bess.) Koch

A perennial herb, with radical leaves, appearing after the bluish or purplish flowers have blossomed, villous with long silky hairs; flowers erect, coming from a simple stem, which is naked except for the involucre; petals wanting, or abortive, stamen-like; sepals petal-like, about 1½ inches long; leaves ternately divided with the lateral divisions 2-parted; stamens numerous; pistils numerous in a head with long, hairy styles, in fruit forming feathery tails.

Distribution. Illinois and Nebraska, Wisconsin, Minnesota, Missouri, N. W. Territory, Rocky Mountains to Texas, British Columbia. Known as the pasque or sand flower, but very commonly and incorrectly called the crocus.

Poisonous properties. A very poisonous plant. The allied European *Anemone Pulsatilla* is also regarded as poisonous. The different parts of the plant are extremely acrid and when applied to the skin cause irritation and vesication. The acridity of the plant is due to the presence of a crystalline substance called *anemonin* $C_{10}H_8O_4$ which when heated with acids,forms *anemonic acid* $C_{10}H_{12}O_6$. Lloyd states:

> All parts of fresh *Anemone patens* are acrid and very irritating. Dr. W. H. Miller informs us that his hands have been very badly blistered, in consequence of the juice having spattered over them while pressing the plant. The vapors evolved from the fresh juice are of such an acrid nature as to have inflamed the eyes, and have closed them temporarily. For this reason, persons refuse to work with the fresh herb, and botanists have been known to severely irritate their hands simply from contact with the recent plant.

The only demand for this plant is by Homeopathic physicians. All portions of the European *Anemone patens* are very acrid, but the dried plant is merely an astringent. The plant evidently contains a volatile acrid substance, which is given off when heat is applied. Our sand flower was one of the chief medical plants of the Indians of Minnesota. The plant is still used, when in a fresh condition by the Indian. Dr. Millspaugh gives the following method for preparing it:

> The whole, fresh, flowering plant is chopped and pounded to a pulp and weighed. Then two parts by weight of alcohol are taken, the pulp thoroughly mixed with one-sixth

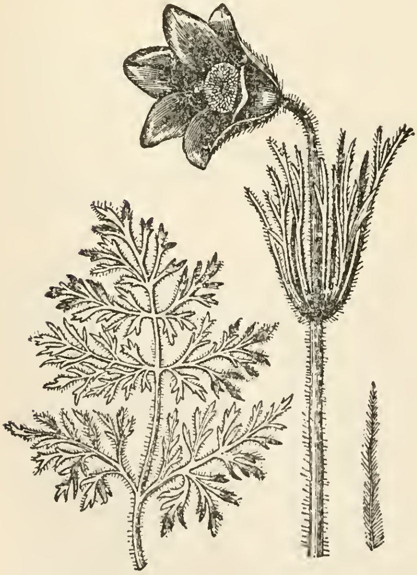

Fig. 227. European Anemone (*Anemone Pulsatilla*). A poisonous plant with acrid properties. (From Vesque's Traité de Botanique.)

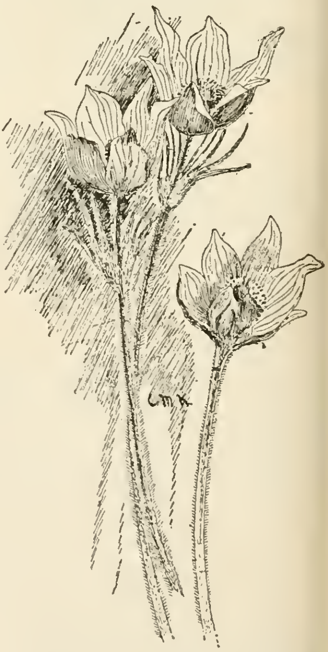

Fig. 228. Pasque Anemone (*Anemone patens*, var. *Wolfgangiana*). A plant with well known acrid properties. (Charlotte M. King.)

part of it, and the rest of the alcohol added. After thorough mixture, the whole is allowed to stand eight days in a well-stoppered bottle. The tincture thus prepared, after straining and filtering, should have a light, seal-brown color by transmitted light, an acrid astringent taste, and a decidedly acid reaction.

Dr. White in his Dermatitis Venenata calls attention to the irritating porperties of the common wind-flower *A. quinquefolia*. The species is widely distributed in woods in Eastern North America. He states that a large wholesale dealer in medical plants regarded it as an externally corrosive poison. It is probable that other species of the genus are more or less acrid. Some of these plants like the white meadow wind-flower *A. canadensis* are probably looked upon with some suspicion. Dr. Johnson in his Manual of Medical Botany, makes this statement in regard to the common Wind-flower:

> Pulsatilla is an acrid irritant which, in large doses, has often produced serious and alarming effects. In safe medicinal doses, however, its effects are by no means so well known. At various times and by numerous authors it has been highly praised as a remedy in diseases of the eye, in rheumatism, amenorrhoea, dismenorrhoea, etc. In this country it has been employed chiefly by homeopathic practitioners, and usually in very minute doses. Many of the results claimed for it under such circumstances are at least doubtful. Certain it is that other practitioners have not been able to confirm them.

Anemone quinquefolia L. Wind Flower

A low smooth perennial with filiform rootstock, involucre or 3-petioled, trifoliolate, toothed leaves, sepals 4-7, ovate, white, pale blue or purple; carpels 15-20 oblong with a hooked beak.

Distribution. In woods from Nova Scotia to Georgia and the Rocky Mountains, also in Europe.

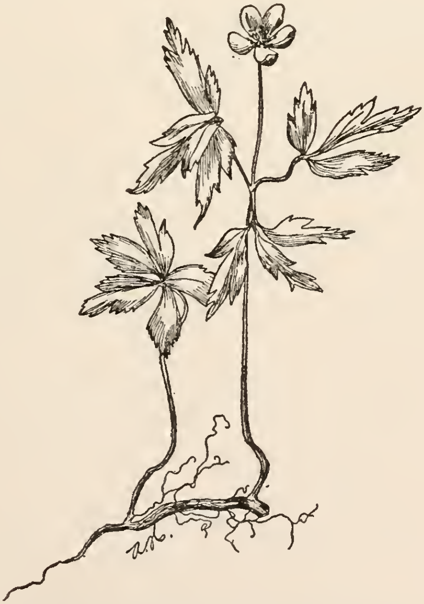

Fig. 229. Wind flower (*Anemone quinquefolia*). A well known plant with more or less acrid properties. (Ada Hayden.)

Poisonous properties. Leaves, roots, and stems are acrid; same properties as in the Pasque Flower.

Anemone canadensis L. Meadow Anemone

A hairy perennial from 1 ft. to 18 inches high; involcure 3-leaved bearing a long peduncle or a pair with a 2-leaved involucre at the middle; radical leaves long, petioled, 5-7 parted or cleft; sepals white 6-9 lines long; head of fruit globose, achenes flat, tipped with stout style.

Distribution. In low grounds, meadows, especially westward from Labrador to Saskatchewan, Colorado to Maryland and New England.

Poisonous properties. All parts of the plants with acrid properties.

5. *Clematis*

Climbing vines or perennial herbs, more or less woody; leaves opposite, slender petioled, pinnately compound, lobed, or entire; sepals 4 or rarely more, petal-like; petals none; stamens numerous; ovaries free; the fruit an achene 1-seeded; style long, persistent, plumose, silky, or occasionally naked. About 100 species of wide distribution, abundant in temperate regions. The most common species in Northern States is the *Clematis virginiana*, in the South and Rocky Mountains, *C. ligusticifolia*; and in the South, the *C. Viorna*, and *C. Pitcheri*. The European *C. vitalba* contains *anemonol.*

Clematis virginiana L. Virgin's Bower

Perennial, climbing, with leaflets mostly broadly ovate, acute, cut low; flowers axillary, clusters panicled, polygamo-dioecious, white; the style persistent, plumose. The western *C. ligusticifolia* is nearly like this species.

Distribution. From Canada to Florida, and Kansas, Nebraska, northward. *C. ligusticifolia* is common throughout the Rocky Mountains from Western Nebraska to the Pacific Coast.

Clematis Pitcheri Torr. & Gray

Perennial herb with pinnately compound leaves, high upper leaves often simple; flowers large, solitary, on long peduncles; usually nodding calyx, bell-shaped; dull purplish sepals, with narrow and slightly margined recurved points; tails of the fruit naked or shortly villous. From Southern Indiana to Central Iowa, and Kansas and Texas.

Poisonous properties. J. U. and C. G. Lloyd, in their Drugs and Medicines of North America, report the medical properties of several species of the genus Clematis as follows:

> It imparts a rank taste, which, after prolonged chewing, becomes acrid and irritating, although at first it is only disagreeable.

Dr. Rusby also mentioned the poisonous character of the species of Clematis. In Cuba, one species of the genus is used in case of tooth-ache to blister the face, and this as well as another species is used in the same way for rheumatism. Dr. J. C. White refers to the European *Clematis recta* as producing blisters and often ulcers, and causing the eyes to water and become inflamed.

> An infusion of the plant in oil has been used to cure the itch, and violent inflammation of the skin has been produced by friction with it.

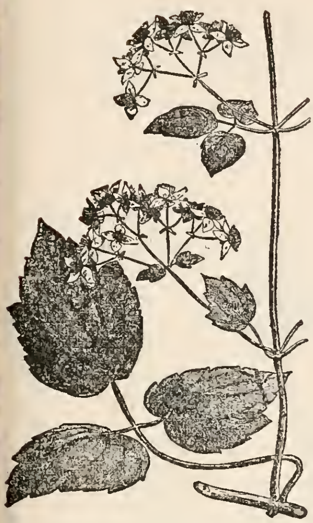

Fig. 230. Virgin's Bower (*Clematis virginiana*). Probably poisonous. (From Johnson's Medical Botany of N. A.)

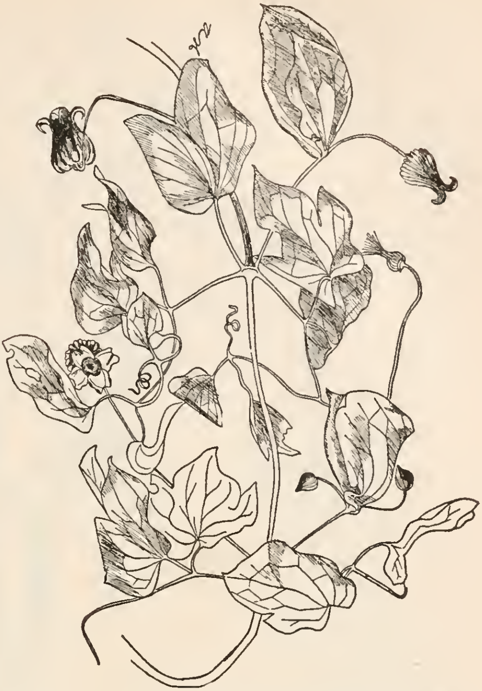

Fig. 231. Clematis, Virgin's Bower (*Clematis Pitcheri*). The flowers are dull purplish in color; the plant is more or less acrid. (Ada Hayden.)

6. *Ranunulucus* (Tourn.) L. Crowfoot Buttercup

More or less acrid, annual or perennial, herbs with alternate, simple, lobed, divided, or dissected leaves; solitary or somewhat corymbed flowers, yellow, white or red; sepals 5; petals 5 with a nectariferous pit or scale at the base; stamens numerous; pistils numerous; achenes numerous in heads, generally flattened or pointed with an erect seed, tipped with the style. About 200 species in temperate and colder regions.

Ranunculus sceleratus L. Ditch Crowfoot

A glabrous annual, 1 foot or more high, stem hollow; root leaves 3-lobed, rounded; stem leaves 3-parted, the lobes cut and toothed; upper leaves nearly entire; flowers pale yellow, petals but slightly longer than the calyx; stamens numerous; pistils numerous, in oblong and cylindrical heads.

Distribution. Wet ditches in the Northern States; also in Europe.

Poisonous nature. The plant is highly acrid, blistering the mouth and skin. In Europe it is used by beggars for making sores. Other species with similar properties are *R. acris, R. bulbosus,* and *R. repens.*

Ranunculus septentrionalis, Poir. Creeping Crowfoot

A low, hairy, or nearly smooth, glabrous perennial; ascending, or often producing long runners; leaves with 3-stalked divisions, the terminal one broadly

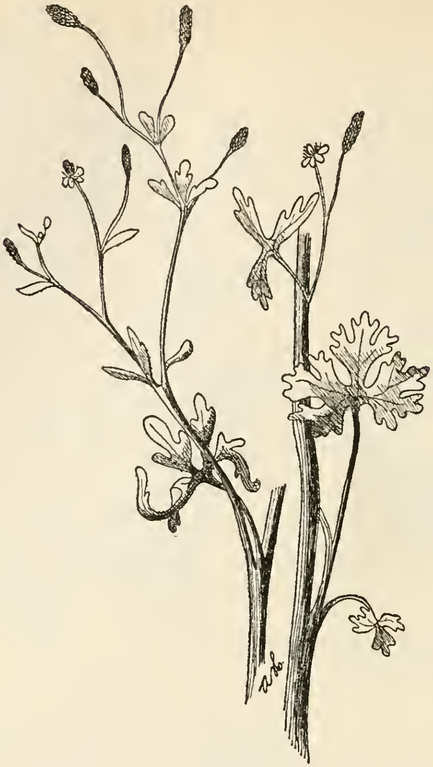

Fig. 232. Cursed Crowfoot (*Ranunculus sceleratus*). Common in low grounds. Contains an acrid poison. (Ada Hayden.)

wedge-shaped, 3-cleft or parted; flowers yellow, petals obovate and larger than the sepals; stamens numerous; pistils numerous; style long and attenuate; fruit an achene.

Distribution. Common in moist shady places in the northern states.

Ranunculus acris L. Tall Crowfoot

Hairy, perennial, with fibrous roots, from 2-3 feet high; basal leaves tufted 3-7 divided, divisions cleft in narrow acute lobes; upper leaves short petioled, 3-parted; petals much longer than the spreading calyx; head when in fruit globose.

Distribution. Native to Europe, widely naturalized in the Northern States and Canada.

Poisonous nature. Juice acrid, poison dissipated on drying. Symptoms produced in animals are blistering, slavering, choking, vomiting, in some cases, followed by death resembling that from apoplexy.

Ranunculus abortivus L. Small Flowered Crowfoot

Smooth, branching biennial from 6 inches to 2 feet high; root leaves round, heart-shaped or kidney shaped, crenate, or lobed; stem leaves sessile or nearly so, divided into oblong linear lobes; flowers small; sepals 5, reflexed; petals 5, yellow; head globose; carpels mucronate with a minute curved beak.

Distribution. In moist woods and meadows; a troublesome weed. Newfoundland to Manitoba, Nebraska, Colorado and Florida.

Poisonous properties. The leaves of the plant have an acrid, peppery taste and cause blistering.

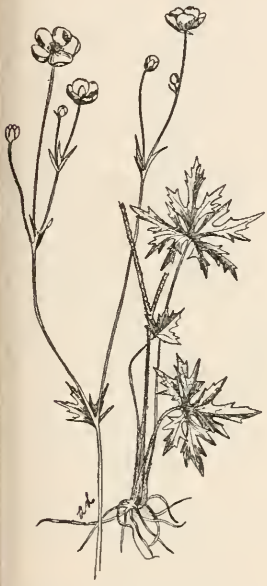

Fig 233. Buttercup (*Ranunculus acris*). The juice of this plant has acrid properties. (Ada Hayden.)

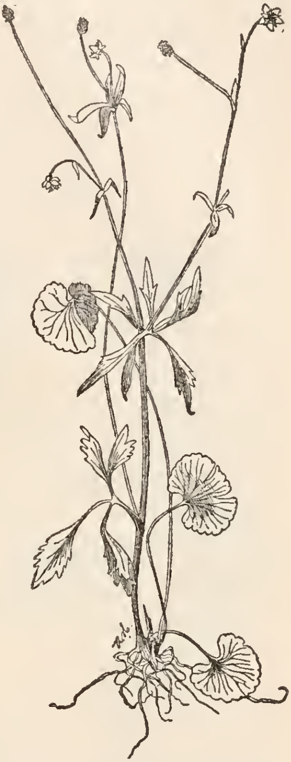

Fig. 234. Small-flowered Crowfoot (*Ranunculus abortivus*). The leaves cause blistering. (Ada Hayden.)

According to Basiner, the oil of Ranunculus acts, in warm-blooded animals, as an acrid narcotic, producing, in small doses, stupor and slow respiration; in larger doses, also, paralysis of the posterior and anterior extremities, and, before death, convulsions of the whole body. The acrid action is shown by a corrosive gastritis and by hyperaemia of the kidneys, more particularly of their cortical substance. *Anemonin* causes similar symptoms, but is followed by no convulsions, nor does it irritate sufficiently to corrode the organs, as the oil does.

Dr. Millspaugh mentions especially the *R. bulbosus* as having a peculiarly powerful irritant action upon the skin, whether applied locally or internally.

Murray states that a slice of the fresh root (bulb?) placed in contact with the palmar surface of a finger brought on pain in two minutes; when taken off, the skin was found without signs of extra circulation or irritation, and the itching and heat passed away; in two hours it nevertheless returned again, and in ten hours a serious blister had formed, followed by a bad ulcer, which proved very difficult to heal.

Stebler and Schröter state that *Ranunculus acris* produces diarrhoea, abortion, and loss of flesh, and when eaten in large quantities, death ensues in a few hours. Dr. Johnson in his Mannual of Medical Botany of North America, says:

> The ranunculi are too acrid to render their internal use either desirable or sáfe. Most of them are avoided by domestic animals; one may often see *R. acris*, for example, growing luxuriantly in pastures where almost every blade of grass is cropped close. Their acrid properties have, however, led to their employment externally as rubefacients or vesicants in cases where other and perhaps better agents were not at hand, or were for any reason contra-indicated. As is well known, cases of idiosyncrasy occur in which cantharides are inadmissible on account of their effect upon the urinary organs. In some such cases ranurculus has been used with good effect. One of the faults of this agent is its extreme violence. The fresh plant, bruised and applied to the skin, may vesicate in an hour or hour and a half, and may possibly produce an ulcer not easy to heal. It is, therefore, far less safe as a rubefacient than mustard, and, as a rule, much less desirable as a vesicant than cantharides. It has been employed to some extent in European countries as an external application in chronic rheumatism, neuralgia, etc., but never sufficiently to have obtained a place in the pharmacopoeias. In this country it is used still less, and is little more than mentioned in works on materia medica. An interesting observation regarding the possible effect of *R. acris* on pregnant cows was reported to the author by his brother, Mr. F. M. Johnson. In a herd of cows pastured for years in succession in an old field thickly beset with this weed, abortion was frequent and troublesome. As soon, however, as this pasture was broken up and the herd moved to another part of the farm in which the plant did not grow, abortion disappeared. Now although, as stated above, domestic animals avoid this plant, yet when feeding where it is very abundant, they must occasionally swallow it accidentally; and though there is no positive proof that the abortions were due to the plant in question, the facts as stated are interesting and significant. It is at least possible that ranunculus exerts an influence upon the reproductive organs like that which is claimed by some for pulsatilla.

Leaves, flowers, and stems of the Ranunculi have a peppery and pungent taste, when eaten, reminding one of mustard. According to Lloyd, boiling water dissipates the acrid principle.

Many other species of the genus *Ranunculus* such as *R. Flammula,* and *R. arvensis* are acrid and poisonous, causing the formation of blisters.

Delphinium Tourn

Perennial or annual herbs of erect, branching habit, with racemose or paniculate showy flowers; leaves palmately lobed or divided; sepals 5, irregular, petal-like, the upper one prolonged into a spur; petals 2-4, irregular, the upper one spurred, and enclosed in the spur of the calyx; stamens numerous; pistils 1-5, forming follicles in fruit, many seeded. Species about 60 in the North temperate regions.

Several species like Stavesacre (*D. Staphisagria*) are used in medicine, and many are poisonous to live stock. Several species like the field larkspur (*D. Consolida*), the rocket larkspur (*D. Ajacis*), the great flowered larkspur (*D. grandiflorum*) and blue larkspur (*D. elatum*), are ornamental.

Delphinium Penardi Huth. Prairie Larkspur

A perennial pubescent or hairy herb, more or less glandular above, from 3-5 feet high; leaves 3-5-parted, the divisions 2 or 3 times cleft, the lobes linear; flowers in racemes; white, slightly tinged with blue; spur horizontal, straight or slightly curved upward; follicle pubescent, many seeded. This is closely related to *D. azureum* of more southern distribution, with light blue flowers and downy follicles.

Distribution. The Prairie Larkspur is common on sandy soil, gravelly knolls and prairies of Illinois and Wisconsin to Manitoba, Kansas and Arkansas.

7. *Delphinium Geyeri* Greene

A hairy perennial 1-2 feet high; leaves dull green, somewhat branched; flowers in dense racemes, azure blue.

Distribution. Common on the high plains of Colorado to Montana.

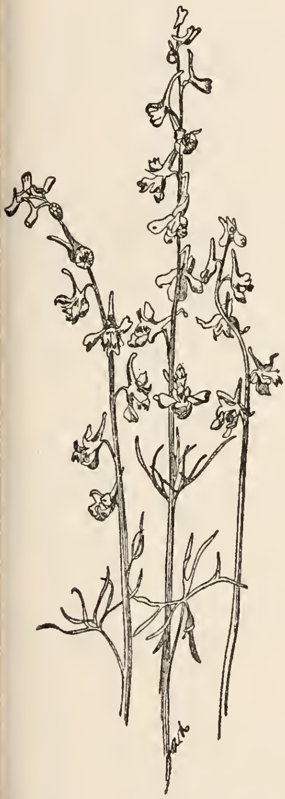

Fig. 235. Carolina Larkspur (*Delphinium Penardi*). Like other species of this genus it is poisonous. Common on prairies and gravelly soil. (Ada Hayden.)

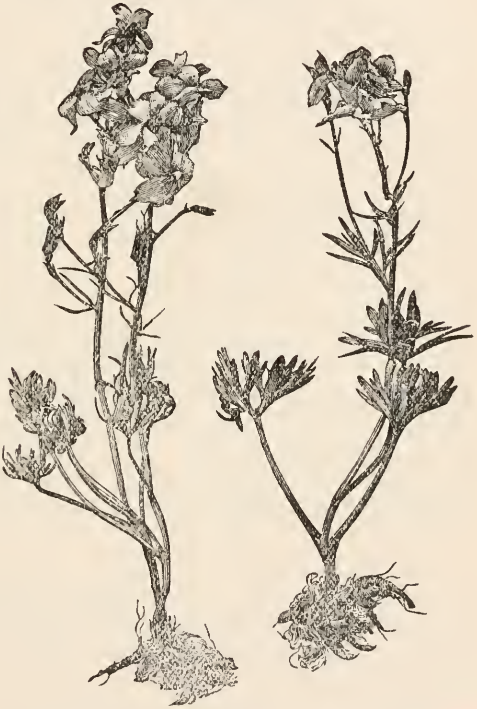

Fig. 236. Purple Larkspur (*Delphinium bicolor*) is found in Montana and Westward. Poisonous. (Chesnut, U. S. Dept. Agr.)

Delphinium Menziesii DC

Glabrous below, at least at the very base, pubescent above with spreading hairs, especially the inflorescence; leaves 5-parted, divisions 2 to 3-cleft; flowers large, deep-blue, in a loosely few to many-flowered simple raceme; upper petals veined with purple; spur long and slender; ovaries somewhat tomentose.

Distribution. Common from San Francisco, California, north to British Columbia, Idaho, Montana and Wyoming.

Poisonous properties. Chesnut and Wilcox say:—

> Experiments have been made which show that at one stage of growth the leaves of the species (*D. Menziesii*) may be safely eaten, to a certain extent, by sheep. Dr. S. B. Nelson, professor of veterinary science in the Washington Agricultural College, in an article entitled Feeding Wild Plants to Sheep, published by the Bureau of Animal Industry of this Department, showed that it is possible to feed as much as 24¾ pounds of the fresh leaves of *D. Menziesii* to a sheep within a period of five days without causing any apparent ill effects. The stage of growth of the larkspur was not stated, but, judging from the other experiments described in the same report, it was probably in a well-advanced flowering stage.

In regard to the poisoning from this species, opinion seems to differ. Dr. Nelson states that Dr. Wilcox was in error in regard to the plant that he worked with at first. More than likely it was a *D. bicolor,* which is corroborated by the report. Under *D. bicolor,* mention is made of *D. Menziesii.* However, it is more than likely there are certain stages in the development which are more poisonous than others. Dr. S. B. Nelson from his experiments concludes as follows:

> The results obtained in these eight trials with *Delphinium Menziesii,* the feeding of nine and one-half pounds of the bulbs, stems and leaves of the immature plants to sheep No. 6, the feeding of nearly twenty-five and six pounds of the plants gathered while in full bloom, to Nos. 2 and 3 respectively, and the hypodermic injections of the two extracts into Nos. 4 and 5, certainly constitute evidence sufficiently convincing to justify the conclusion that *Delphinium Menziesii* is not poisonous to sheep and they may be allowed to graze where it grows even in abundance without fear of any loss from it.

Dr. Nelson likewise carried on an experiment with *D. simplex* with similar results.

Delphinium bicolor Nutt. Purple Larkspur

A smooth or somewhat pubescent, tuberous rooted, perennial; 1-2 feet high with a cluster of finely divided leaves; the lower orbicular in outline, all deeply cleft or parted; racemes few or several-flowered; flowers dark purple; sepals and spur ½ to ¾ inch long; upper petals pale yellow, and white with blue veins, follicles smooth or minutely pubescent when young.

Distribution. Common in dry ground, Eastern Oregon, and Washington, to Utah, British Columbia, Montana, and Colorado. Grows in elevations from 4000 or 5000 feet to 10,000 feet.

Poisonous character. It is regarded as poisonous by stockmen. Experiments reported by Dr. Wilcox in the Montana Agricultural Experiment Station Bulletin show that an extract from less than one ounce of the dried leaves of this species was fatal to a yearling lamb. Chesnut and Wilcox report further experiments as follows:

> The following experiments were made with a view of ascertaining whether the permanganate of potash, which it was proposed to use in many cases of plant poisoning, could be used with satisfactory results as a chemical antidote in case of this plant, and also of determining which parts of the plant were most toxic. During some seasons the purple larkspur causes extensive poisoning of sheep and calves. Cattle and horses, on the other hand, seem to eat it less frequently than the tall larkspur. In the season of 1900 conclusive evidence against this plant was obtained in only one locality. This was derived from two cases among calves in the Flathead Valley. The calves were about 5 weeks old, and at the time when the poisoning occurred, were running in a native pasture where the purple larkspur grew sparingly. The symptoms of poisoning in these two cases were similar to those already outlined from poisoning in the tall larkspur in cattle, with the exception that a slight bloating was to be observed in the case of the calves. The respiration and heart beat became exceedingly rapid as the symptoms of poisoning increased in severity. The body temperature was slightly lowered, and this was accompanied by pro-

fuse sweating. The increased perspiration may have been due in part to the violent spasms in which the animals finally died. Death occurred about four hours after the appearance of the first symptoms. No remedy was applied in these cases.

Delphinium scopulorum Gray

A glabrous or finely pubescent perennial with leafy stem 1-6 feet high from fascicled thick roots; leaves numerous orbicular, 5-7, parted, lower cuneate, and the upper consisting of narrow, cleft, and laciniate divisions; racemes many-flowered, sparingly pilose, flowers blue varying to white or pink on short erect pedicels; spur longer than sepals, lower petals deeply notched, and upper whitish, and a little shorter than the oblong sepals; follicles about half an inch long, erect, seeds small, with a loose coat.

Delphinium occidentale Watson. Tall Larkspur

A glandular pubescent perennial from 4-6 feet high; leaves deeply 3-5 cleft, divisions broadly cuneate, somewhat 3-lobed; flowers numerous in a many-flowered sparingly-branched panicle; sepals spatulate, acuminate; dull or dark blue, very variable in size; seeds light colored, and somewhat spongy.

Distribution. At higher altitudes from Colorado to Eastern Oregon, and Nevada.

Delphinium trolliifolium Gray. California Cow Poison, or Poisonous Larkspur

A tall smooth perennial, 2-5 feet high, sparingly villous, hairy; leaves large, long, petioled, 5-7 lobed, lobes lacinately cleft and toothed with acuminate segments; flowers large in loose racemes; color bright blue, 1½ inches broad, spur as long as the sepals; sepals oblong-lanceolate, acuminate, sparingly villous, follicles smooth, 6-8 lines long, seeds turbinate.

Distribution. Common along the Pacific Coast from British Columbia to California.

Poisonous properties. Prof. Chesnut says: "In Humboldt County, Cal., it is known as Cow Poison on account of its fatal effect on cattle. Its toxic character has been questioned. Perhaps it is not equally poisonous throughout all stages of its growth."

Delphinium tricorne Michx

A simple stout perennial 6 inches-2 feet high, with a cluster of roots; leaves slender, petioled, deeply 5-7-cleft, or divided; the divisions linear or ovate; flowers in loose racemes, blue, occasionally white or purple; spur slightly bent. Follicles tipped with a short beak.

Distribution. In open rich woods or clay soil, Western Pennsylvania to Southeastern Iowa to Arkansas and Georgia.

Poisonous properties. The Stavesacre (*Delphinium Staphisagria*) of Italy and Greece to Asia Minor has long been used in medicine, having been known to the ancients. Pliny mentions the use of the powdered seeds for destroying vermin on the head. It is still largely used for destroying pediculi. The eclectic physicians use it for its specific action on the reproductive organs. The disease produced by *Delphinium* may be called delphinosis.

According to Prof. Hills, Stavesacre and *D. Consolida* are used in the treatment of dropsy and spasmodic asthma. The effects produced are due to

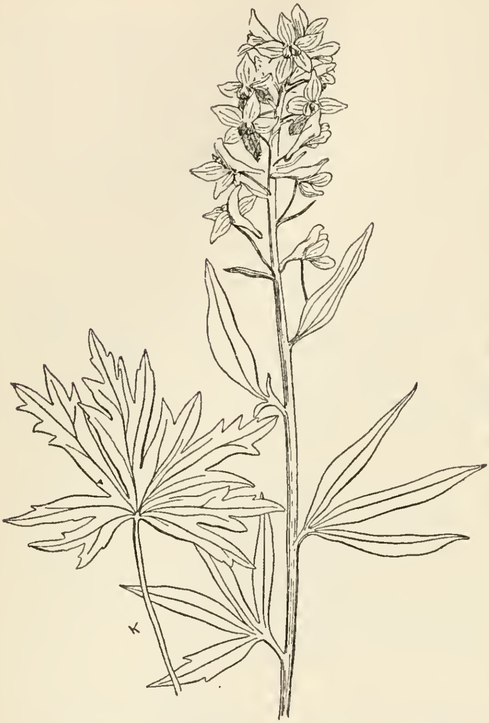

Fig. 237. California Cow Poison (*Delphinium trolliifolium*). A species common along the Pacific coast, and said to be fatally poisonous to cattle. (Ada Hayden.)

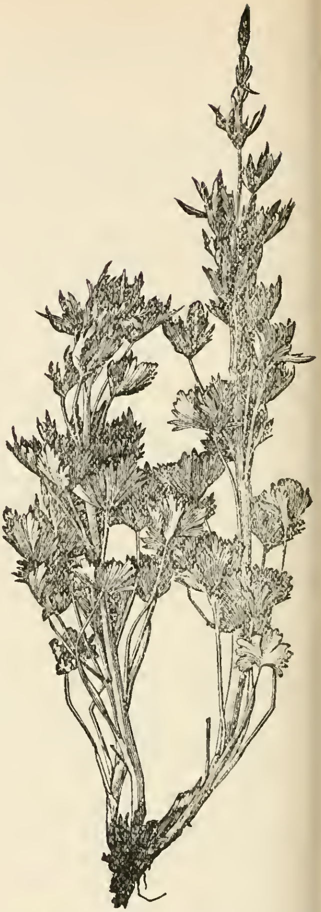

Fig. 238. Tall Larkspur (*Delphinium glaucum*) of the Pacific Coast region. It is poisonous. (Chesnut, U. S. Dept. Agrl.).

the alkaloid *delphinin* $C_{22}H_{35}NO_6$, very poisonous with a bitter sharp taste. Three other alkaloids have been isolated, *staphisagrin* $C_{22}H_{22}NO_5$, bitter, the poisonous *delphinoidin* $C_{42}H_{58}N_2O_7$, and *delphisin* $C_{27}H_{46}N_2O_4$, an extremely poisonous alkaloid, to which may be added the substance *calcitripin.* Dr. J. C. White in his Dermatitis Venenata states that acute dermatitis resembling eczema may appear from the use of stavesacre seed. *Delphinocurarin* $C_{23}H_{33}NO_7$, has been obtained from the root stock of several species of Delphinium, *D. bicolor* contains 0.27 and *D. scopulorum*, 1/3 per cent.

In this country, it appears, from Mr. Cheney's observation, that *D. consolida* is largely sold for the European plant. A tincture of the seed is often mixed with *Lobelia inflata* and sold as a parasiticide. The Stavesacre seeds are still employed as in old times for the destruction of pediculi in human beings. For this purpose, they are converted into powder and dusted among the hair.

Results of the experiments made by Dr. Crawford of the U. S. Dept. of Agr. show in 1905 in regard to larkspur poisoning. (The first batch of plants was collected April 26th, 1905).

1 c. c. injected into a guinea pig (subcutaneously), weight 730 grams. Caused no disturbance.

3 c. c. in guinea pig, no symptoms.

6. c. c. in guinea pig, killed.

6 c. c. injected into guinea pig, 285 grams, killed in 33' minutes.

4 c. c. injected into guinea pig, 352 grams, no symptoms.

Repeated:

5 c. c. killed guinea pig weighing 196 grams. Died in 55 minutes.

4 c. c. injected into guinea pig, 299 grams. No symptoms.

Evidently lethal dose for this solution lay between 4 to 5 c. c.

Second Stage, Gathered May 16th, 1905

Solution corresponding to 4 c. c. of No. 1 caused no symptoms in guinea pig weighing 445 grams, while 5.3 c. c. killed one of 350 grams, but death was delayed longer than with extract of first stage.

Third Stage, Gathered in June, 1905

Solution corresponding to 4 c. c. caused no symptoms in guinea pig weighing 376 grams.

5.3 c. c. caused no symptoms in guinea pig weighing 500 grams.

6.6 c. c. caused no symptoms in guinea pig weighing 480 grams.

Evidently a lethal dose is much higher and the plant loses much of its activity in development.

This report is very conclusive in proving that the plant contains an active poison, and further in substantiating the claims of experienced observers that the plant loses much of its toxic properties as it approaches the flowering period.

Seven and one-half grams of dried purple larkspur fed to each of three rabbits on April 20th. No results.

Seven and one-half grams of fresh purple larkspur from same patch fed April 25th to each of three rabbits. Two showed slight uneasiness, and one was bloated a little. One, showing less effect than the others, had eaten but three and one-half grams.

On May 1st a like quantity from the same patch was given to the same rabbits under similar conditions. Results, two died, and the other distressed.

On June 15th, plants from the same source, being in full bloom, but the leaves and stems dry, were fed to rabbits. Although very hungry, they at first refused to eat, but later ate large quantities of it without any ill effects. The experiments with tall larkspur were equally as confusing. The fact that the plants at one period of growth gave negative results was no guaranty that they would not be dangerous at another. The tall larkspur growing luxuriantly on the college campus proved to be very active, physiologically, and furnished the best specimens for producing the physiological effects upon animals. In the experiments with antidotes this domesticated species was found to be very poisonous while in bloom in the middle of August.

Lloyd in Drugs and Medicines of North America, quotes from a letter from Wm. C. Cusick, a botanist of the West, who states that in some places the *D. decorum F. & M. var. nevadense* poisons cattle, but only in the early spring when they are first turned on the crop. It is thought by cattle men that the cattle pull the plants up by the roots and eat them, which really causes the poisoning. Many die, but most recover. Prof. Chesnut, in his Principal Poisonous Plants of the United States, says:

> The percentage of fatal cases in cattle which have eaten this and other larkspurs is said to be small. A rough estimate by a cattleman places it at about 20 per cent for one species of the group, when the animals are not properly treated, and 5 per cent otherwise. This is probably a low estimate, however, for in a case of poisoning from *D. Menziesii* that occurred in Montana in May, 1897, and was reported by Dr. E. V. Wilcox, nearly 600 sheep were affected, 250 of which died.

Dr. Wilcox says in regard to *D. glaucum*:

> The tall larkspur appears not to be eaten by sheep. All cases of poisoning from this plant observed in Montana during this year and previous years have been among cattle. As already indicated, sheep are not driven to the mountain ranges until about the middle of July, and at this season the tall larkspur is altogether too large and coarse for their consumption. It is well known, on the other hand, that cattle will feed on much coarser forage than sheep, and at the same time they are allowed to run on the high ranges in the early spring. In Montana the light green tufts of leaves of the tall larkspur first become conspicuous about the last of April or the first of May, and the flowers begin to open about the middle of June. This fact is significant for the reason that light falls of snow often occur in the larkspur belt as late as the first week in June, and, since there is then no other verdure in sight, the uncovered portion of the larkspur is in a high degree tempting to stock, all the more because it is succulent. The danger is increased by the fact that at the time of snow falls cattle seek the shelter of creeks where the larkspur is more abundant and most advanced in growth. At this period, moreover, the leaves are, as we can testify from personal observation, very bitter, and they are probably then more poisonous than at any other stage of growth. The older ones, as is also the case with the blue larkspur, are not so bitter. The plant is recognized by cattlemen as dangerous to cattle from May until about the middle of June. Mr. Vard Cockrell informs us that on his range in the lower basin of the Gallatin it is the sole duty of one man during this period to keep his cattle away from the broken mountainous regions where this larkspur abounds.

The symptoms are described as follows:

> In general, the animals affected manifest symptoms similar to those produced by overdoses of aconite. The first signs of poisoning are usually a general stiffness and irregularity of gait. There is often a pronounced straddling of the hind legs in walking. These symptoms increase in severity until locomotion becomes difficult or impossible, and the animal finally falls to the ground. It usually falls and gets on its feet again a number of times, the muscular movements becoming more and more irregular and incoördinated. At the same time the skin is very sensitive to touch, and the muscles of the sides and legs soon begin to quiver spasmodically. This a very characteristic symptom, being usually exhibited for several hours. The function of the special senses is seldom impaired, the animal being apparently able to hear and see as well and as correctly as under conditions of health. Although a slight increase in the quantity of saliva is to be noticed in some cases, this symptom is never so pronounced as in cases of poisoning by death camas. During the later stages of poisoning the animal is usually attacked with violent convulsions, in one of which it finally dies. In this respect, also, the symptoms differ distinctly from those of death camas poisoning, which is usually quite without spasms. The digestive functions seem not to be affected by larkspur poisoning The temperature is lowered slightly during the first stages, in one instance having been as low as 97°. During the later stages the pulse becomes very frequent and the breathing rapid and shallow. The cerebral symptoms are simply those of excitement, and the appetite seems not to be lost until shortly before death.

In regard to *D. bicolor*, the symptoms observed from experiments are described by the same author as follows:

> Summing up the results of these experiments, we find that the most prominent, easily observable symptoms were a stimulation of the respiration and a brain symptom manifested by dizziness or a rhythmical movement of the head. As it was not the object of the experiment to determine the symptoms of poisoning, these having been already secured by Dr. Wilcox, no special effort was made to determine the pulse rate, but it was to be noted that in experiment 2, which was as nearly fatal as any, the heart action was extremely rapid and weak. None of the experiments proved fatal and no results were obtained on which

a satisfactory trial of the permanganate of potassium as an antidote could be based; hence no experiments were made in that line.

Dr. B. Kennedy in the Nevada Agricultural Experiment Station, reports in regard to the symptoms of poisoning from *D. glaucum*, as follows:

> This dangerous, poisonous plant was seen quite frequently from Lincoln Valley to Summit Soda Springs. It occurs usually in large patches by the side of creeks in the valleys. Although sheep do not care for it, yet it is sometimes eaten by them. Sheepmen do not consider it dangerous. Cattlemen, however, are afraid of it, and consider it very poisonous. Mr. Ridinger of the Tehauntepec dairy, about eight miles from Webber Lake, told us that cattle die after eating it, with the following symptoms: Trembling and shivering, succeeded by extreme weakness, which makes affected animals stagger and fall or lie down.

That Larkspur is poisonous, at least some species, appears from the experiments carried on by Dr. Geo. H. Glover and C. Dwight Marsh:

> There can be no question but that the several species of larkspur growing native in the mountainous districts of Colorado are a greater source of loss to the stockmen than all other weeds combined. While the larkspur is confined to the mountainous regions, it nevertheless holds true that in the aggregate mortality throughout the state from poisonous plants larkspur takes second place only to loco. We have no statistics at hand whereby we can estimate, with any degree of accuracy, the total loss, but judging from the reports of other western states and from information received from most every section of the state, it would seem that $40,000 annually is a conservative estimate. There are four species of larkspur found growing abundantly in the middle and western portion of this state, and one found growing sparingly in the eastern plains section. Other species have been found in isolated places, but have not been especially accused of doing any harm, and their toxicity has not been proved. The four species found in the greatest abundance and named in the order of their importance, are purple larkspur, *Delphinium Nelsonii, Greene*; tall larkspur, *Delphinium elongatum, Rydb.; D. Geyeri, Greene,* and *D. Barbeyi, Huth.* These all have the same characteristic flowers, and are found growing in the mountains at altitudes from 5,000 to 11,000 feet. The *D. Penardi,* Huth, has a white flower and may be seen growing adjacent to streams and in the arroyas on the plains as far east as the state line.

The *Delphinium elongatum* and *D. Nelsonii* are the only ones which contain a sufficient quantity of deleterious substance to produce poisoning. From all accounts it seems probable that the plants are most poisonous in the spring when they are fresh. When the poison has been absorbed into the system atropin is an antidote.

8. *Actaea* L. Baneberry

Perennial herbs with 2 or 3 ternately-compound leaves; sepals 4-5, petal-like, soon falling; petals 4-10, small, flat, spatulate, on slender claws; stamens numerous, free, with slender white filament; ovary solitary; stigma sessile; fruit a berry; seeds compressed, smooth, horizontal.

Actaea rubra (Ait.) Willd. Red Baneberry

A smooth perennial 1-3 feet high with biternately divided leaves, on long, smooth petioles, leaflets ovate, sharply cut, and toothed. Calyx with 4 greenish sepals; corolla 8-10 petals, white, shorter than the stamens; stamens numerous; berries cherry red.

Distribution. Eastern North America to Hudson Bay, and the Rocky Mountains.

Poisonous properties. Prof. Chesnut states that sheep are occasionally poisoned by eating the leaves of the closely related European species. These plants are seldom, however, eaten. In its medical action Actaea is similar to Cimicifuga. It contains a resinous body which is neither acrid nor bitter, but according to Fred Stearns, the rhizome has purgative properties. This, according to Mr. Lloyd, may be somewhat overdrawn. Prof. Sayre states that it is a violent purgative, irritant and emetic. The berries are known to be somewhat poisonous.

9. *Hydrastis* Ellis. Yellow Puccoon

A low perennial herb with knotted yellow rootstock, and a single root; stem bearing 2 leaves near the summit; flowers large, greenish-white; 3 sepals, petal-like, soon falling; petals none; pistils 12 or more; 2-ovuled; fruit 1 to 2-seeded berry, crimson in color. A genus of 2 species

Hydrastis canadensis L. Golden Seal. Yellow Puccoon

Rootstock 1 and 2 inches long, knotted; berries numerous, small; fibrous root, roots and rootstocks yellow in color; leaves pubescent, palmately 3-5-lobed; calyx petal-like.

Distribution. From New York to Southern Michigan, Southern Wisconsin and Eastern Iowa to Arkansas to Northern Georgia.

Poisonous properties, also medicinal properties. The plant contains the alkaloid *berberin* $C_{20}H_{17}NO_4$, and *hydrastin* $C_{21}H_{21}NO_6$, a so-called alkaloid, but which, according to Mr. Lloyd, cannot be considered in the pure condition; also *canadin* $C_{20}H_{21}NO_4$ and *xanthopuccin*; it also contains a fixed oil of a disagreeable odor and taste, and a black resinous substance. It produces ulceration and catarrhal inflammation of the mucous surfaces. The plant acts very similarly to *Cimicifuga.* The Lloyds have given an extended account of the anatomy, structure and therapeutical properties of this plant. The alkaloid *berberin* $C_{20}H_{17}NO_4$ is identical with the substance found in the barberry, according to Prof. Power.

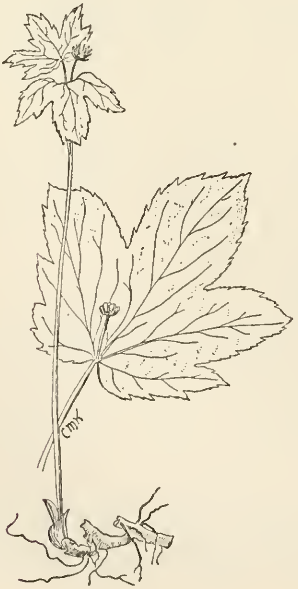

Fig. 239. Golden Seal (*Hydrastis canadensis*). The rootstocks of this plant as well as the stem and leaves contain more or less acrid substances. (Charlotte M. King).

BERBERIDACEAE. Barberry Family

Shrubs or herbs, with alternate leaves; stipulate or exstipulate flowers either solitary or in racemes, perfect; stamens as many as petals and opposite them, hypogynous; fruit a berry or capsule. A small family of about 20 genera and 105 species, widely distributed in the North Temperate region, also in Temperate South America and Asia. Some of our North American species are weedy, others woody and several are more or less poisonous. A few like the common barberry (*Berberis vulgaris*), blue cohosh or pappoose root (*Caulophyllum thalictroides*), the twinleaf (*Jeffersonia diphylla*), and mandrake (*Podophyllum peltatum*) are used in medicine. The root of *Berberis aristata* and *B. vulgaris* sometimes used as a fish poison. Probably some other members of this order are poisonous. The blue cohosh (*Caulophyllum*) contains *saponin*. This plant is said to be extremely bitter to the taste, but is not, however, common.

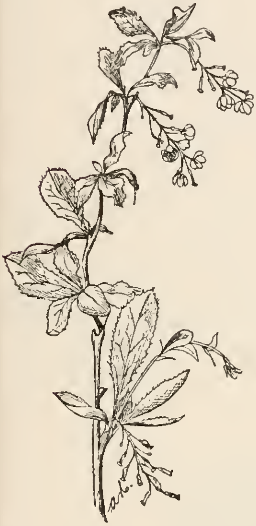

Fig. 240. Common Barberry (*Berberis vulgaris*). The spines often inflict mechanical injuries while the leaves and wood are more or less poisonous. (Ada Hayden).

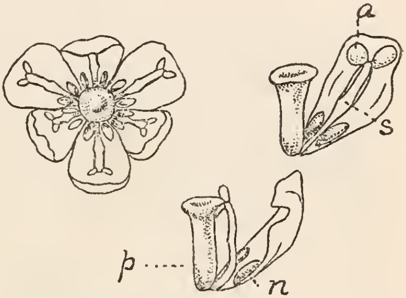

Fig. 240a. Single flower. s, stamen; a, anther; p, pistil; n, nectar gland.

Key for genera

Herbs with simple large leaves..............................1. Podophyllum.
Shrubs with unifoliate leaves......................................2. Berberis

1. *Podophyllum* L. Mandrake; May-apple

Perennial herbs with simple, smooth, erect, stem; creeping rootstocks and thick fibrous roots; stems bearing 2 leaves with large flowers; flower buds with 3 green bractlets, 6 fugacious sepals; petals 6-9; stamens twice as many as the petals; pistil 1; stigma large, flat, sessile; fruit a large fleshy berry, 1-celled and many-seeded, each seed enclosed in a pulpy aril.

4 species, one in eastern North America and the others in India and Eastern Asia. The *P. emodi* of Asia contains the same principles as the American species and is poisonous.

Podophyllum peltatum L. Mandrake

Perennial herb, with creeping rootstocks and thick fibrous roots; flowering stems with 2-leaves, 1-flowered, the flower bud with 3 small green bractlets, which fall away early; calyx of 6 unequal sepals, corolla white, of 6-9 petals, about twice the length of the sepals; stamens 12-18, twice the number of petals, inserted below the pistils, with short stamens; anther cells opening longitudinally; creeping rootstock, from 1-5 feet long, fibrous rooted.

Poisonous properties. Its medicinal virtues were well known to the Indians of North America, and an early writer, Catesby, remarked that the root was an excellent emetic. It has a bitter, acrid taste, similar to that of roots of other plants of the family. Its active properties seem to reside in the resinous substance. Prof. Power failed to find an alkaloid. The name *podophyllin* has been given to the product found in the resinous substance contained in other members of the family. This in turn contains *podophyllotoxin* $C_{11}H_{14}O_2+2H_2O$, and *picropodophyllin* $C_{11}H_8O_2+H_2O$, producing a very bitter taste; and intensifying the action of *podophyllin. Berberin* $C_{20}H_{17}NO_4$, which is feebly toxic to man, and *saponin* have also been found. Cases of poisoning have occasionally

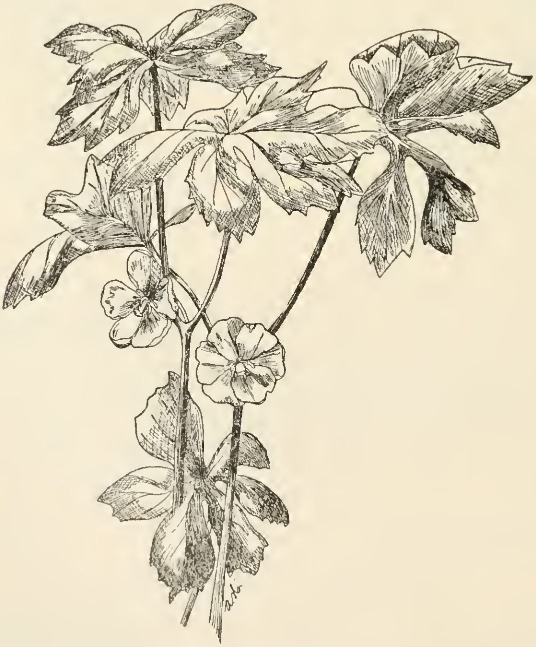

Fig. 241. Mandrake (*Podophyllum peltatum*). powerfully purgative. (Ada Hayden).

been reported. It produces fatal prostration. It seems to exert a special influence upon the liver. Dr. Rusby says:

> Its taste, especially when fresh, is very repugnant, and yet if eaten in quantities it would unquestionably prove fatal, as shown by the effects of over-dosage in medicine. In the Philadelphia Medical and Surgical Reporter, XIX, 308, a fatal case is recorded in which the evidence is perfectly clear that poisoning resulted from continued large doses administered by an ignorant and careless physician. The poisonous symptoms were all referable to the bowels, those of enteritis. It is also very interesting to note the peculiar effects of poisoning of the external skin by the powder and by the resin of this drug. It produces an ulcer of a very peculiar character, closely resembling one of venereal origin. Serious errors of diagnosis, leading to the gravest injustice to the reputation of the patient, have been known to occur in reference to these cases. A very serious ulcer upon the eye-ball is among these recorded cases. The very greatly elongated rhizome of *Podophyllum*, with its very long smooth internodes, broadened nodes with their very large, low, cup-shaped ears, and sparse roots underneath, is doubtless well known to all pharmacists. The plant is not only very common, but extremely abundant east of the Mississippi, and is liable to be encountered almost anywhere."

In regard to its action on man, Dr. Millspaugh says:

> Here the same action takes place, but extends to the rectum with sufficient intensity to cause prolapsus and hemorrhoids. The first effect of the drug is an excitation of salivary and biliary secretions, followed by torpor and icterus. The symptoms of disturbance caused by the drug in doses varying from ¼ to ½ grains of "*podophyllin*," and in persons working in the dust of the dried root, are substantially as follows: Inflammation of the eyes, soreness and pustulation of the nose; salivation and white-coated tongue; extreme nausea, followed by vomiting severe pains in the transverse colon and abdomen, followed by an urgent call to stool; thin, offensive, copious stools; weak pulse, prostration, drowsiness, and cold extremities.
>
> Among other experiments with this drug upon animals, those of Dr. Anstie seem to be the most characteristic. He found, resulting from his many applications of an alcoholic solution to the peritoneal cavity direct, that no local inflammation arose, although an intense hyperaemia occurred in the duodenum especially, and the whole of the small intestine, even going so far as to cause a breaking down of the tissues and resulting ulceration, causing discharges of glairy mucus streaked with blood; this hyperaemia ceased usually at the ileocaecal valve. Post mortem: The mucous-membranes were found inflamed and covered with bloody mucus. Other observers noted that retching, salivation, and emesis, followed by purging, colic, and intense tenesmus, with low pulse, and rapid exhaustion followed the administration of the drug.

Dr. Schaffner says:

> Roots, stems, and leaves, drastic and poisonous, but the ripe fruit less so. Leaves, when eaten by cows, produce injurious milk. The ripe fruit may be eaten in small quantities.

The root of Mandrake affects the skin. Mr. Lloyd, in White's work, writes:

> Our employes experience great trouble in working this, owing to the irritating action of the skin. We have in numerous instances had our men cease work for several days owing to its action, which causes very painful inflammation of the skin, especially of the eyes.

Dr. Winslow says:

> The action is exerted mainly on the duodenum, which is intensely inflamed and even ulcerated in poisoning. *Podophyllin* directly increases the secretion of bile in small doses, while purgative quantities hasten its excretion by stimulation of the muscular coat of the gall bladder (except in the horse) and small intestines. It is probable that the intestinal secretions are somewhat augmented. The faecal movements, after medicinal doses of podophyllin, are liquid, often stained with bile, and may be accompanied by some nausea and griping.

Berberis L. Barberry.

Shrubs with yellow wood, simple or compound leaves, often spiny; flowers, yellow in racemes, or rarely axillary; sepals 6-9, like petals; petals 6, imbricated in 2 series; stamens 6; fruit a berry with 1-3 seeds. About 75 species of wide distribution.

Berberis repens Lindl. Trailing Mahonia.

A smooth, trailing shrub, 1-4 ft. high, leaves petioled, pinnate; leaflets 3-7, ovate, acute; flowers several in a raceme, yellow; persistent bracts; fruit globose, bluish purple.

Distribution. From Western Nebraska to Arizona, and British Columbia, Northwest Pacific Coast from Washington to California.

Berberis Aquifolium Pursh. Oregon Grape.

A low shrub 2-10 feet high, leaflets 5-9 oblong ovate, spinulose dentate above; flowers yellow in racemes and terminal clusters; fruit globose, dark in color.

Distribution. Idaho to the Rocky Mountains.

Poisonous properties. Both *Berberis repens* and *B. Aquifolium* contain the alkaloids *berberin, oxyacanthin* $C_{19}H_{21}NO_3$, and *berbamin* $C_{18}H_{19}NO+2H_2O$.

Prof. Schaffner reports that the berries of the trailing Mahonia are injurious to birds. When eaten fresh they are emetic and cathartic.

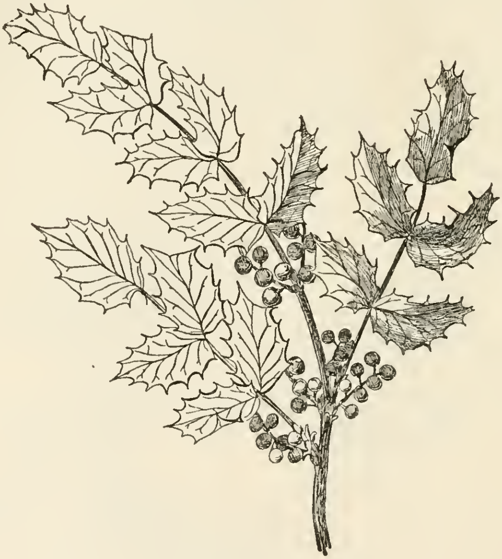

Fig. 242. Oregon Grape (*Berberis Aquifolium*). Berries are said to be poisonous to birds. (Ada Hayden).

MENISPERMACEAE. Moonseed Family

Woody plants with alternate lobed or entire leaves, climbing without stipules; flowers small, dioecious, in panicled racemes or cymose clusters; sepals 4-12; petals 6; fewer, or more; stamens of the same number or fewer; fruit a 1-seeded drupe; embryo long, curved endosperm scanty. About 300 species mainly in the tropics.

Moonseed (*Menispermum canadense*) is a beautiful native climber of the North with black drupes and contains *menispin.* The Carolina moonseed (*Cocculus carolinus*) is common in the South. Fish poison made from *Anamirta* *paniculata* is used for destroying vermin and to poison fish. The wood of this species is very bitter to the taste and contains an alkaloid *menispermin* $C_{38}H_{24}NO_4$ and a toxic substance *picrotoxin* which is said to be a mixture of two bodies *picrotoxin* $C_{15}H_{16}O_6$ and *picrotin* $C_{15}H_{18}O_7$. The Columba Root (*Jateorrhiza Columba*) is used as a medicine and contains several alkaloids, among them, *berberin* and *columbamin*. The false Columba Root (*Cascinum fenestratum*) produces a yellow dye. The alkaloid *pelosin* is obtained from *Chondrodendrum tomentosum*.

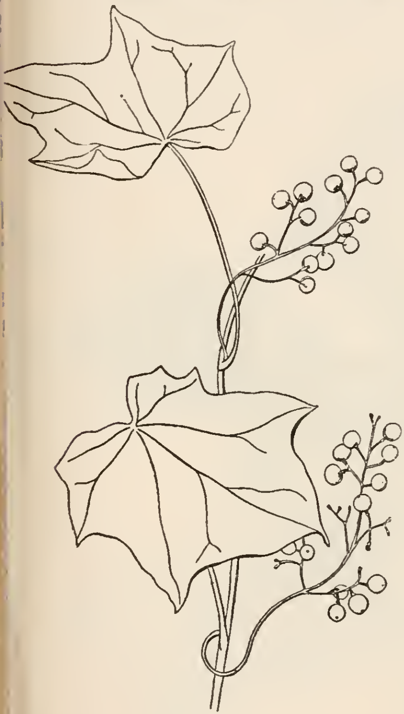

Fig. 243. Moon-seed (*Menispermum nadense*). The fruit is blue, much the lor of Concord grapes. Plants like the h poisons belonging to the same order are nown to be poisonous. This plant has been spected of being poisonous. (Charlotte M. ing).

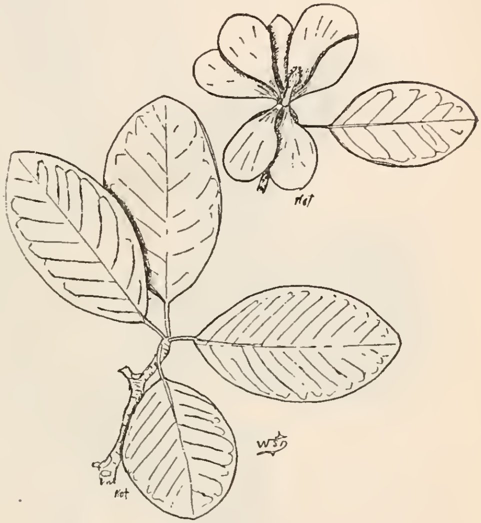

Fig. 244. Laurel Magnolia (*Magnolia virginiana*). A well known flowering shrub or small tree of the Southern states, well known as an ornamental plant.

MAGNOLIACEAE. Magnolia Family

Trees or shrubs, leaves alternate; leaf buds covered by membranous stipules; flowers large solitary; sepals and petals hypogynous, colored alike; stamens numerous, adnate anthers, carpels numerous, separate, or coherent, packed together, ripening into an aggregate fruit; seeds 1-2 in each carpel, achenes or follicles, endosperm fleshy; embryo minute. About 70 species of North America and Asia. The bark of several species used in medicine.

The family *Magnoliaceae* contains the well known magnolias planted for ornamental purposes. Among these are the great flowered magnolia (*Magnolia* *grandiflora*) which has evergreen leaves and fragrant flowers and is extensively planted in the South; the sweet bay (*M. virginiana*) a shrub or small tree with fragrant flowers; the cucumber tree (*M. acuminata*); the umbrella tree (*M. tripetala*); the Yulan tree (*M. Yulan*) of China and Japan; the purple magnolia (*M. obovata*); the tulip tree (*Liriodendron Tulipifera*) frequently planted as an ornamental tree and producing the most valuable timber of the family; the star anise (*Illicium floridanum*) of the south has aromatic bark and pods. The fruit of *I. anisatum* of Japan, found growing around Buddist temples, furnishes the poisonous *sikimin*; from the same species in China is made the liquor anisette; Anise is furnished by *I. anisatum*.

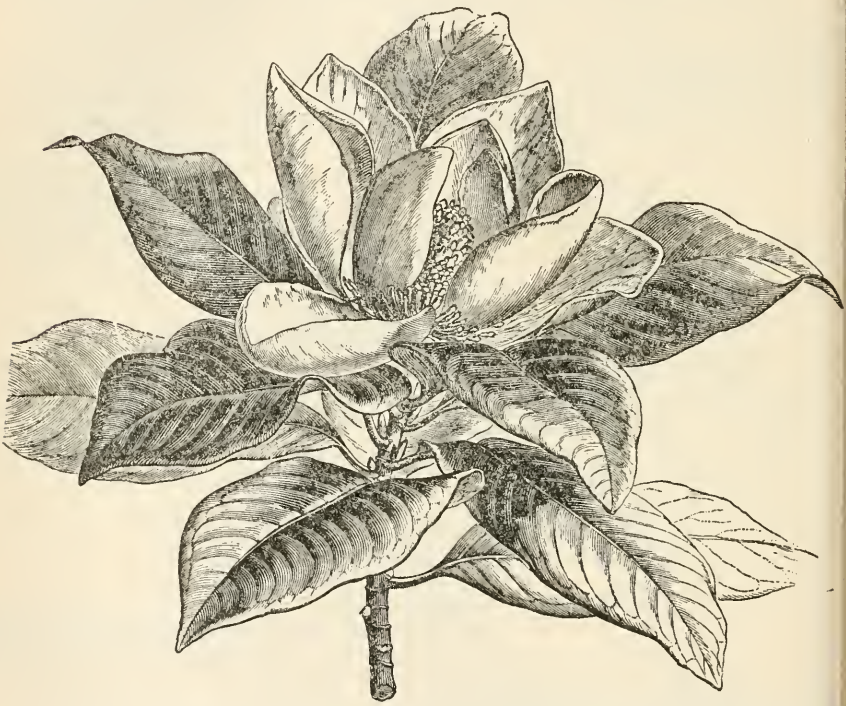

Fig. 245. Great-flowered Magnolia (*Magnolia grandiflora*). An ornamental tree of the southern United States. (After Faguet). The odor of the flowers said to be injurious to some people.

Poisonous properties. The crystalline substance *magnolin*, a glucoside, and a volatile oil occur in the large leaved Magnolia (*M. macrophylla*) of the south. The tulip tree contains the bitter principle *liriodendrin*, also an alkaloid, and a glucoside. The *Talauma macrocarpa* of Mexico contains a haemolytic substance capable of dissolving the red corpuscles of the blood. The flowers of *Michelia nilagirica* are used in perfume. The winter's bark (*Drimys Winteri*) is used in medicine.

Illicium anisatum of Japan is said to contain a poison belonging to the *picrotoxin* class, says Blyth. In 1880 five children in Japan were poisoned by eating the seeds of this plant; three died. After considerable experimentation

Dr. Langaard concluded that all parts of the plant were poisonous. The poison causes excitation of the central apparatus of the medulla oblongata and clonic convulsions analogous to those produced by *picrotoxin, toxiresin* and *cicutoxin.* Small doses kill by paralyzing the respiratory center. Large doses cause heart paralysis. When animals are poisoned by small doses chloral hydrate is an efficient remedy but has no effect when large doses have been taken.

CALYCANTHACEAE

Shrubs with entire short petioled opposite leaves, without stipules; flowers fragrant, large, solitary, on leafy branches, sepals and petals numerous; stamens numerous, the inner short, sterile; pistils numerous; fruit of an ovoid pyriform receptacle, enclosing few to many smooth solitary achenes; seed erect. About 5 species of North America and Asia. Several species are cultivated for ornamental purposes.

Calycanthus L. Carolina Allspice.

Flowers purple or red; sepals and petals numerous, stamens numerous, pistils numerous. A small genus of 4 species, 3 in Eastern North America, and 1 on the Pacific Coast.

Calycanthus floridus L. Strawberry Bush

A branching shrub 3-9 feet high; branches pubescent; leaves oval, soft, downy underneath, roughish above; flowers dark purple, with the odor of strawberries; sepals and petals linear-oblong.

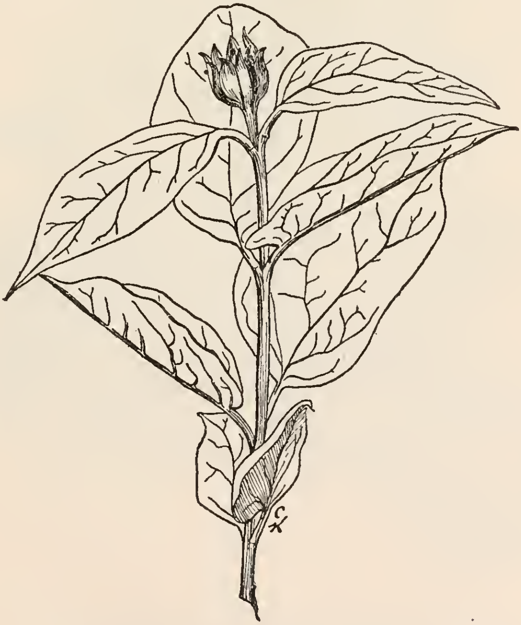

Fig. 246. Strawberry Bush (*Calycanthus floridus*). Commonly used as an ornamental shrub and is known to be somewhat poisonous. (Charlotte M. King).

Distribution. In rich soil, North Carolina to Georgia, Alabama and Mississippi, cultivated in Missouri, north to Central Iowa.

Poisonous properties. This plant contains several alkaloids among them *calycanthin.* Chesnut says:

> The large oily seeds of the calycanthus, or sweet-scented shrub are strongly reputed to be poisonous to cattle in Tennessee.

Anonaceae. Papaw or Custard Apple Family

Trees or shrubs, generally aromatic; leaves entire, alternate, stipules absent; flowers with calyx of 3 sepals and a corolla of 6 petals in 2 rows; hypogynous; anthers adnate, filaments very short; pistils many, separate, or cohering in a mass, fleshy or pulpy in fruit; seeds large with a hard seed-coat, small embryo and copious endosperm. About 550 species, many in the tropics.

Asimina Adans. North American Papaw

Shrubs or small trees with solitary flowers from the axils of the leaves of the preceding year; sepals ovate, petals 6, imbricated in the bud; pistils few, ripening into 1; large and oblong, pulpy, several seeded fruits; seeds horizontal, flat. A small genus of about 7 species, natives of eastern North America and of Asia.

A. triloba Dunal. American Papaw

Shrubs or small trees with thin, obovate-lanceolate leaves, petals dull purple.

Distribution. Along streams from Ontario and New York to McGregor, Iowa, Nebraska and Texas.

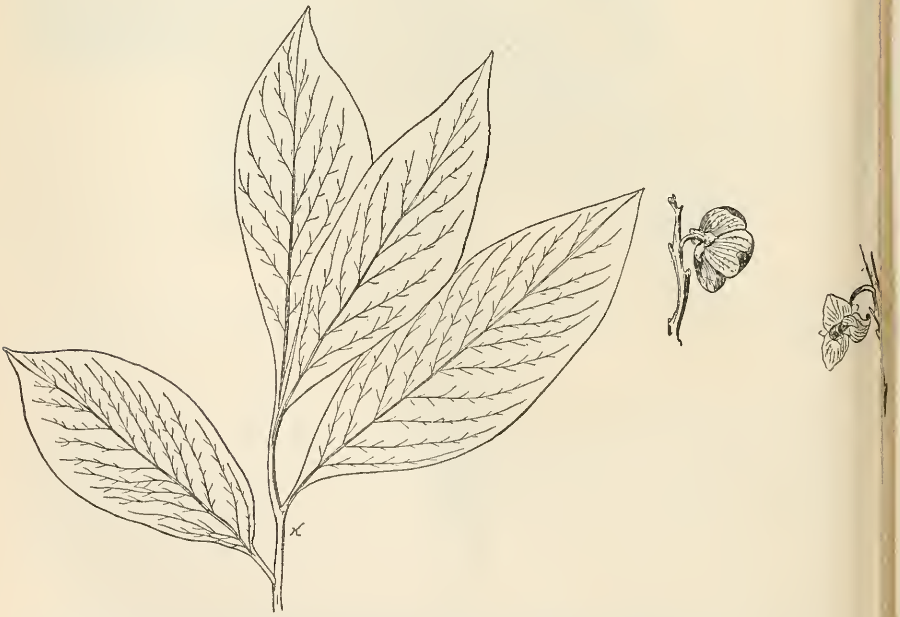

Fig. 247. Common Papaw (*Asimina triloba*). Common in woods of the South. (Charlotte M. King).

Poisonous properties. While the papaw is edible, there are some cases of poisoning on record. Care should therefore be exercised in its use. The leaves contain alkaloids. The papaw (*Polyalthia argentea*) contains *asimin,* a tasteless amorphous alkaloid.

LAURACEAE

Aromatic trees and shrubs with alternate or rarely opposite leaves without stipules; flowers small, fragrant, polygamous, dioecious or monoecious; calyx 4-6 parted; corolla absent; stamens in 3 or 4 series on the calyx, some imperfect; fruit a 1-seeded berry or drupe; endosperm none. About 1000 species, mostly tropical.

The spice-bush (*Benzoin aestivale*) produces fragrant flowers and aromatic leaves. *Camphor* $C_{10}H_{16}O$ is obtained from *Cinnamon Camphora* which comes from the islands of Formosa and Japan; cinnamon, a well known spice, comes from *C. zeylanicum,* which is extensively cultivated in Ceylon; cassia is from *C. Cassia.* Cassia and cinnamon were well known to the ancient especially to the

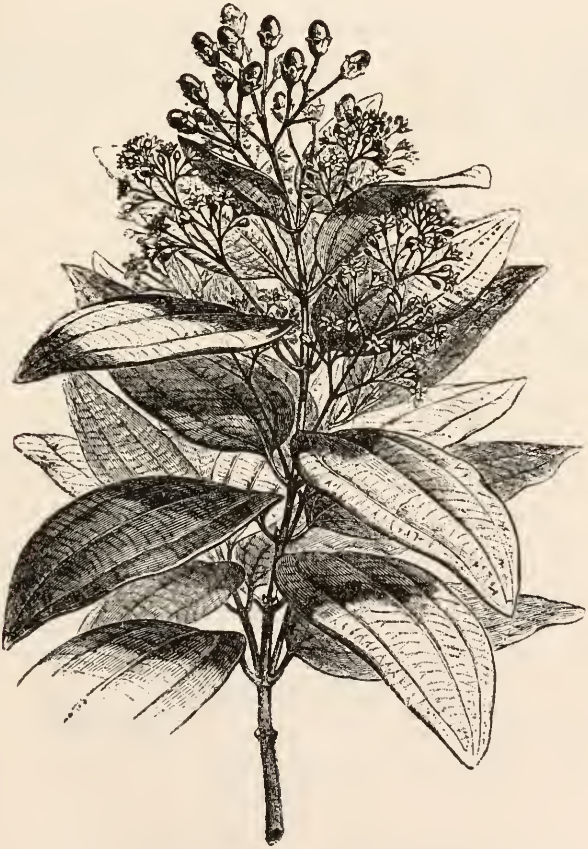

Fig. 248. Cinnamon Tree (*Cinnamomum zeylanicum*). Flowering and fruiting branch. The cinnamon of commerce is the bark of this tree. (After Faguet).

Israelites who used them as incense on their altars. The oils derived from these plants are excellent antiseptics.

Cinnamomum contains a volatile oil *camphorin* which is found in the roots and leaves; *eugenol* occurs in the leaves, stems and bark. Clove bark is derived from a small Brazilian tree (*Dicypellium caryophyllatum*) belonging to this family. The alligator pear or avocado (*Persea gratissima*), a native of the West Indies and tropical America, is much esteemed as a dessert fruit and in making salads. Rolfs has written of its successful culture in Florida. It is said that the oil is used extensively in America in soap manufacture. Leaves of laurel (*Laurus canariensis*), native to Canary and Medeira Islands, and bay (*L. nobilis*) of southern Europe are used in culinary processes. *Nectandra Rodioei* contains *berberin,* which is identical with the *pelosin* $C_{18}H_{21}NO_3$ of *Cissampelos Pancina.* The Indian laurel contains *laurotetanin* $C_{19}H_{23}NO_5$. The California laurel (*Umbellularia californica*) is a strong local anaesthetic said to be irritant and acrid. The leaves, according to the Indians, will drive flies away.

Sassafras Nees

Trees with spicy aromatic bark; small mucilaginous twigs and foliage; flowers greenish yellow, naked in racemes; calyx 6-parted spreading, sterile, with 9 stamens, 3 inner with pair of glands; fertile flowers with rudiments of stamens; ovoid blue drupes.

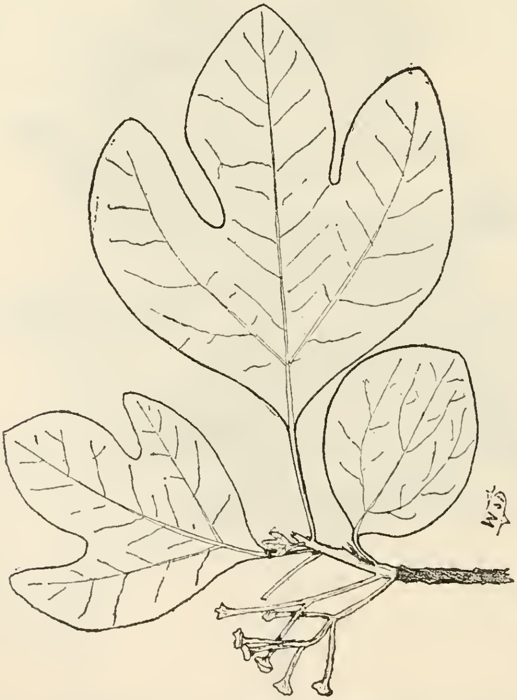

Fig. 249. Sassafras (*Sassafras variifolium*). A well known tree of the south which furnishes the sassafras oil and bark of commerce. (W. S. Dudgeon).

Sassafras variifolium (Salisb.) Ktze. Sassafras

Leaves oval and entire, mucilaginous, or 2-6 lobed to about the middle and often as wide as long, membranous, pinnately veined, petioled; stamens about equaling the calyx-segments; fruiting pedicles red, much thickened below the calyx.

Distribution. From E. Mass. to S. E. Iowa, Kansas and southward.

Poisonous properties. It is said to be poisonous; its bark however is used medicinally as a tonic and its wood is valuable.

RHOEADALES

Mostly herbs with regular and perfect flowers; sepals and petals usually present; polypetalous; stamens free; ovary superior, free from the calyx, compound, composed of 2 or more united carpels. It contains the families *Resedaceae,,* *Cruciferae* and *Papaveraceae.* The mignonette (*Reseda odorata*) is a well known, cultivated, fragrant plant of the family *Resedaceae,* which also includes the dyers weed (*R. luteola*), the latter contains the substance *luteolin.*

Families of the Order Rhoeadales

Sepals generally 2; endosperm fleshy........................Papaveraceae.
Sepals or divisions 4-8; endosperm none.
  Capsule 2-celled; sepals and petals 4, flowers regular, stamens, usually tetradynamous .... Cruciferae.
  Capsule 1-celled; sepals and petals 4, flowers regular or irregular .... Capparidaceae.

PAPAVERACEAE. Poppy Family

Annual or perennial herbs, with milky or colored juice; leaves alternate, stipules none; perfect, regular, or irregular flowers; sepals 2, occasionally 3, falling when the flower expands; petals 4-12, spreading, soon falling; stamens inserted under the pistils, distinct; pistil 1, many ovuled, chiefly 1-celled; fruit a capsule containing numerous oily seeds. Genera 24-26, species about 200. Widely distributed chiefly in north temperate zone.

Comparatively few of the plants of this family are weedy and quite a number are medicinal and poisonous. The common poppy (*Papaver somniferum*) is used in medicine. It is found as an escape near buildings, especially in sections where Germans have settled, undoubtedly due to the fact that they cultivate it for its beauty as an ornamental plant, and use the seeds in culinary operations. The poppy is largely cultivated in China, Smyrna, Joppa, and several countries of Europe and India, for the opium. Opium yields a large number of alkaloids. The more important of these are *morphin,* and *codein.* A perfectly harmless oil equal to olive oil is obtained from the seed. The seed is also fed to birds. The red poppy (*Papaver Rhoeas*) is sometimes cultivated. A syrup is made from the petals, and also a coloring matter used in red ink. The California poppy (*Eschscholtzia californica*) is a valuable soporific, and analgesic "free from the disadvantages of opium." The Indians, according to Chesnut, use it to stupify fish. Celandine (*Chelidonium majus*) native to Europe, has been naturalized in places in the East and is occasionally somewhat weedy. The juice of this plant is yellow, while that of the common cultivated poppy is white, and that of the blood root (*Sanguinaria canadensis*) is reddish. The

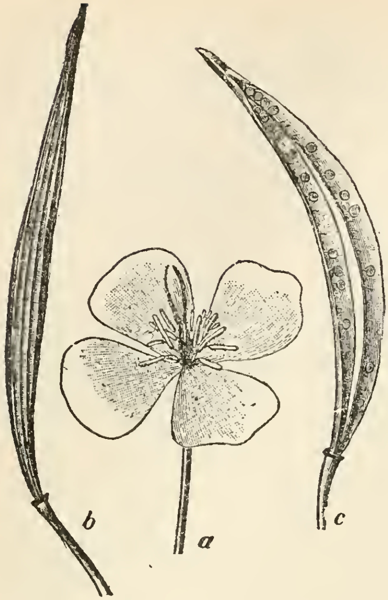

Fig. 250. California Poppy (*Eschscholtzia californica*). *a*, flower; *b*, fruit before, and, *c*, after dehiscence. The juice of this plant is a valuable soporific. (After Strasburger, Noll, Schenck and Schimper).

rhizome of the blood root is used in medicine and contains an alkaloid *sanguinarin* and a dye. The *corydalin* is found in a species of the genus *Dicentra* The bleeding heart (*Dicentra spectabilis*), native to China, and the climbing fumitory (*Adlumia cirrhosa*) are frequently cultivated for ornamental purposes. According to Blyth, the root of the tuberous-rooted corydalis (*Corydalis tuberosa*) contains eight alkaloides; of which *corydalin* $C_{22}H_{27}NO_4$ is the most important, since, when taken in large doses it may cause epileptiform convulsions, death taking place from respiratory paralysis. The *C. lutea* contains *corydalin.* Schlotterbeck and Watkins found 5 alkaloids in the American celandine (*Stylophorum diphyllum*) among them chelidonin $C_{20}H_{19}NO_5+H_2O$. The alkaloids stylopin $C_{19}H_{19}NO_5$, protopin $C_{20}H_{19}NO_5$, and sanguinarin, have been in part found in other plants in the family.

Genera of *Papaveraceae*

Petals 8-12; pod 1-celled 2-valved.
    Petals white; rootstock short red..........................3 Sanguinaria.
Petals 4; pod 2-valved or more.
        Flowers yellow.......................................4 Chelidonium.
    Pod 4-20 valved.
        Ovary incompletely many celled...........................1 Papaver.
        Stigmas and placentas 4-6................................2 Argemone.

1. *Papaver.* Poppy

Plant with milky juice, leaves lobed or dissected, alternate, flowers and buds nodding; sepals 2 or occasionally 3; petals 4-6; stamens numerous, ovules numerous; stigmas united into a persistent disk; capsule globose, obovoid or oblong; seeds small, with minute depressions. About 25 species, natives mostly of the Old World. *P. nudicaule* is found in high mountains in the Rockies and in the Alpine regions of Europe and Asia.

Papaver somniferum L. Garden Poppy

An erect glaucous herb; leaves clasping, large, oblong, wavy, lobed or toothed; flowers broad, bluish-white with purple centre; filaments somewhat dilated, capsules smooth.

Distribution. Native to Asia, but widely naturalized in Europe, and extensively cultivated in China, India, and Smyrna. Occasionally found spontaneous around gardens in North America.

Poisonous and medical properties. From the milky exudation that comes from making an incision in the unripe capsule, opium is obtained which yields not less than 5 per cent of crystallized morphin and occasionally as high as 22 per cent in Turkey opium, the usual yield being between these two extremes. The chief markets for opium are Turkey, Asia Minor, India, and Egypt, that of Smyrna being considered to be the best although good opium has been grown in the United States. This opium has a sharp, narcotic odor, and a bitter taste. Opium has been a fruitful source of a large number of alkaloids. Flückiger and Hanbury enumerate the following: "*Hydrocotarnin, morphin, pseudomorphin* $(C_{17}H_{18}NO_2)_2+H_2O$, *codein, thebain* $C_{19}H_{21}NO_3$; *protopin, laudanin* $C_{20}H_{25}NO_4$; *codamin, papaverin* $C_{20}H_{21}NO_4$; *rhoeadin, meconidin, cryptopin, laudanosin, narcotin* $C_{22}H_{23}NO_7$; *lanthopin, narcein* $C_{23}H_{27}NO_8+3H_2O$; *gnoscopin.*" The most important of these are *morphin* $C_{17}H_{19}NO_3+H_2O$. a colorless or white and shining, odorless substance with a bitter taste; and *codein* $C_{18}H_{21}NO_3+H_2O$, a nearly transparent odorless substance with a faint-

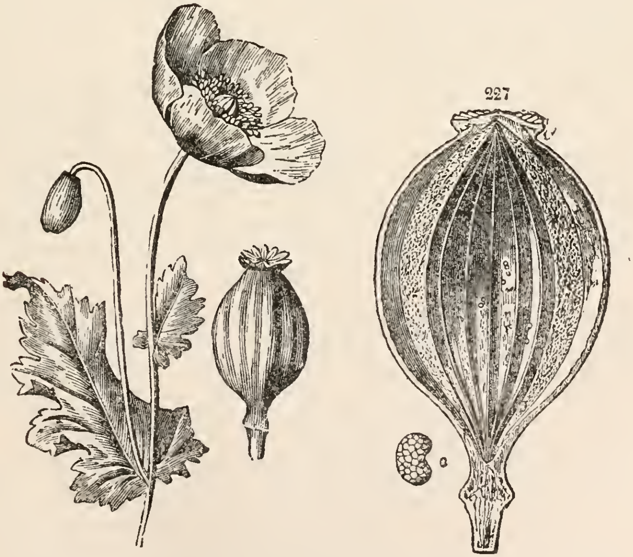

Fig. 252. Garden Poppy (*Papaver sominferum*). Flower and capsule. Opium is made from the milky juice exuding from the unripe capsule. (Faueg).

ly bitter taste which occurs in amounts varying from 0.5-2 percent. *Narcotin* is found in quanties varying from 0.75-9 percent.

It may be of interest in this connection to state that the German chemists Wolfgang, Weichardt, and Stadlinger found toxins in opium. These writers expressed the opinion that the complex physiological action is due to these substances.

In regard to the properties of opium, Flückiger and Hanbury speak as follows:

> Opium possesses sedative powers which are universally known. In the words of Pereira, "it is the most important and valuable medicine of the whole Materia Medica;" and we may add, the source, by its judicious employment, of more happiness and, by its abuse, of more misery than any other drug employed by mankind.
>
> There are occasionally cases of poisoning from the poppy plant. Certainly cases from overdoses of opium are frequently recorded in the annals of medical jurisprudence.
>
> Opium may be absorbed to a slight extent by the unbroken skin, according to Winslow, and causes a mild, anodyne action. Opium diminishes the two principal activities of the digestive organs, namely, secretion and motion. The action upon the alimentary tract in lessening secretion, is partly a local one and partly constitutional, following the absorption of the drug. The mouth is made dry, thirst is increased and appetite impaired. Opium is absorbed rather slowly from the stomach and bowels, and stimulates the splanchnic nerve centre of the sympathetic system, which inhibits the movements of the stomach and intestines, and thus lessens peristaltic action of these organs. Opium is directly opposed to belladonna in this respect, as the latter drug paralyzes the intestinal inhibitory apparatus (splanchnic endings), and so increases peristalsis.
>
> The most important action of opium is upon the nervous system, and its influence is more powerful upon man than upon lower animals. At first, opium exerts a stimulating influence upon the spinal cord. Ruminants are comparatively insusceptible to opium. Dr. Winslow says: "Ounce doses of the drug cause, in cattle, restlessness, excitement, hoarse bellowing, dry mouth, nausea, indigestion and tympanites. Sheep are affected in much the same manner. One or two drachms of morphine have led to fatality in cattle. Fifteen to thirty grains of the alkaloid comprise a lethal dose for sheep. Swine are variously influenced, sometimes excited, sometimes dull and drowsy.

According to the same authority, its action on horses causes drowsiness, sometimes, and at other times produces no visible effect,

> Four to six grains, given in the same way, cause restlessness, a rapid pulse, and moisture of the skin. The animal paws the ground and walks in a rhythmical manner about the stall. The pupils are dilated. Large doses (12 grains) are followed by increased excitement, sweating, muscular rigidity and trembling; while still larger doses (four drachms of the extract of opium) cause violent trembling, convulsions, insensibility to pain and external irritation, without coma; or (morphine, gr. 36 under the skin) stupor for several hours (3 hours), dilated pupils and blindness, followed by delirium and restlessness, continuing for a longer time (7 hours) and ending in recovery. Horses have recovered from an ounce of opium, but 2½ ounces of the drug, and 100 grains of morphine have proved fatal.

Dr. Winslow is here quoted upon the toxicology of opium:

> The symptoms of poisoning have already been sufficiently described in previous sections. The treatment embraces irrigation of the stomach, or the use of emetics, as apomorphine hydrochlorate under the skin, and the subcutaneous injection of strychnine and atropine sulphate in the first stages, and enemata of hot, strong, black coffee; leading the animal about slapping him, or using the faradic current. Dr. Moor, of New York, has apparently found in potassium permanganate the most efficient antidote for opium and morphine. Ten to fifteen grains, dissolved in eight ounces of water, should be given by the mouth, to large dogs. One to two drachms of potassium permanganate may be administered to horses in two or three pints of water. Permanganate solution oxidizes and destroys morphine, and should be acidulated with a little vinegar or diluted sulphuric acid, after the ingestion of morphine salts. The antidote has been recommended to be given subcutaneously after absorption, or hypodermic injection of morphine, but this is not of the slightest use. Hypodermic injections bave not infrequently caused poisoning.

Papaver Rhoeas L. Corn Poppy

An erect annual with hispid spreading hairs; lower leaves petioled, the upper, smaller, sessile, pinnatifid, lobes lanceolate, acute, and serrate; flowers scarlet with darker center; filaments dilated; capsule smooth with 10 or more stigmatic rays.

Distribution. In waste places along the Atlantic and Pacific coasts. It is frequently cultivated.

Poisonous properties. Poisonous like other species of this genus.

Freidberger and Fröhner give the symptoms of poisoning from this plant as colic, constipation, tympanites in cattle, raging fit of fury in horses.

In India this species is a troublesome weed but the seeds are collected and a yellow acrid oil obtained therefrom which is used both in medicine and as an illuminant.*

2. *Argemone* L. Prickly Poppy

Herbs with yellow juice; spiny toothed leaves and stems; flowers large; sepals 2-3; petals 4-6; stamens numerous; styles short; stigma 3-6-radiate; capsule prickly, oblong, opening by 3-6 valves; seeds small, numerous.

A small genus of about 8 species of the southern states, Mexico and Western North America.

Argemone mexicana L. Mexican or Prickly Poppy

A glaucus annual from 1-3 feet high, with spines or without; leaves sessile, clasping by narrow base, glaucus, runcinate-pinnatifid, spiny-toothed; flowers large, whitish or generally yellowish; calyx with 2 sepals, bristly pointed; stamens numerous; stigma sessile, seeds numerous, reticulated.

Distribution. Introduced along the Atlantic coast as far north as the middle states. Native from Florida to Texas. A most common and troublesome weed in Texas. It yields however a valuable painter's oil.

Argemone intermedia Sweet. Prickly Poppy

A spiny, leafy, plant from 2-2½ feet high;setose, hispid; flowers large white, sepals green, hispid; petals obovate; capsule armed with stout spines; horns with a terminal spine; seeds numerous, black sunken meshes.

Distribution. From Central Kansas, Nebraska, South Dakota, to the Rocky Mountains and Texas. Common in dry soil.

Poisonous properties. The small prickles cause somewhat painful injuries when they penetrate the skin. According to Schlotterbeck the *A. Mexicana* contains *fumarin* $C_{20}H_{19}NO_5$ and *berberin.* In Mexico used in the same way as the poppy.

Sanguinaria L. Bloodroot

Perennial with a horizontal, thick rootstock; juice red; leaves basal, palmately veined and lobed, heart-shaped or reniform; flowers white; sepals 2, soon falling; petals 8-12, arranged in several rows; stamens numerous; placentae 2; capsule oblong, dehiscent to the base; seeds smooth, crested. A single species.

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* D. Hooper. Agrl. Ledger 1907:35.

Sanguinaria canadensis L. Bloodroot

Calyx; sepals 2, light green, falling as the bud opens; petals 8-12 or more, ½ to 1 inch long, oblong-spatulate, spreading, white or slightly rose-tinted, increasing in size for two or three days after the bud opens, and then falling away; stamens about 24, in several rows, much shorter than the petals, those in the inner rows longest; anther narrow, opening longitudinally.

Distribution. In rich woods, N. S. to Manitoba, Neb., Fla. and Ark.

Poisonous and Medical Properties. Lloyd in White's book on dermatitis, writes:

> There are two native drugs that are very irritant to mucous surfaces, so much so that the dust is very disagreeable, and we presume that they would have a similar irritating action on the skin: Bloodroot, and *Caulophyllum thalictroides,* blue cohosh or pappoose-root.

Bloodroot has a bitter and acrid taste due to the substance *sanguinarin.* In small doses, this substance exerts a tonic influence, promoting gastro-intestinal secretion and thus aiding digestion. On its physiological action, Dr. Millspaugh says of *sanguinarin* $C_{20}H_{15}NO_4$: "This alkaloid is very acrid to the taste, and toxic, and causes violent sneezing." Millspaugh gives its physiological action as follows:

> Sanguinaria in toxic doses causes a train of symptoms showing it to be an irritant; it causes nausea, vomiting, sensations of burning in the mucous membranes whenever it comes in contact with them, faintness, vertigo, and insensibility. It reduces the heart's action and muscular strength, and depresses the nerve force, central and peripheral. Death has occurred from overdoses, after the following sequence of symptoms: violent vomiting, followed by terrible thirst and great burning in the stomach and intestines, accompanied by soreness over the region of those organs; heaviness of the upper chest with difficult breathing; dilation of the pupils; great muscular prostration; faintness and coldness of the surface, showing that death follows from cardiac paralysis.

Rusby says:

> The effects of *Sanguinaria canadensis* L., or blood root are distinctly poisonous and Johnson definitely records that fatal results follow overdoses. Yet the rhizome is not at

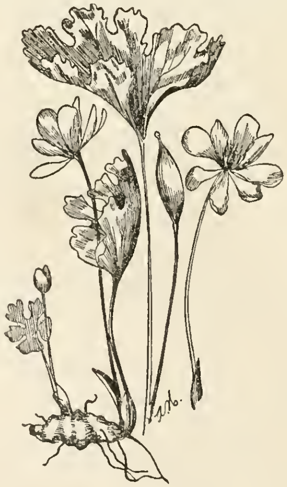


Fig. 253. Blood root (*Sanguinaria canadensis*). The colored latex contains poisonous alkaloids.

all liable to be eaten, on acount of its peculiar blood red color, which is forbiddingly suspicious, and more especially because of an exceedingly acrid taste which would render the chewing and swallowing of a poisonous quantity an act of heroism. It is exceedingly common throughout the northeastern United States, and in a number of localities within a few miles of this city. The root also contains *chelerythrin, homochelidonin* and *protopin.*

4. *Chelidonium* L

Erect branching herbs, with alternate deeply pinnatifid leaves; yellow juice and flowers; 2 sepals; 4 petals; stamens numerous; distinct styles; capsule linear, dehiscent to the base; seeds smooth, shining, and crested.

Distribution. A genus of one species, native to Europe, but widely naturalized in North America.

Chelidonium majus L. Celandine

Flowers consisting of 2 sepals which are ovate, yellowish, soon falling; corolla 4 petals, contracted at the base; stamens numerous, shorter than the petals.

Poisonous and Medical properties. The alkaloid *chelerythrin* $C_{21}H_{17}NO_4$ is identical with the *sanguinarin* of the last plant. *Chelidonin,* $C_{20}H_{19}NO_5$ H_2O, an alkaloid existing particularly in the root, is colorless and bitter. *Homochelidonin,* consisting of three basic substances is found in *Bocconia, Sanguinaria, Adlumia* etc. This plant produces congestion of the lungs and liver; it is also an excessive irritant, and has a narcotic action upon the nervous system, in its action resembling gamboge. On this point Dr. White says:

> Mr. Cheney informs me that he has known the plant to poison the skin, if handled so as to crush the leaves or stem. To indicate this extent to which it is used in medicine, it may be stated that a collector in North Carolina offers fifteen hundred pounds of the leaves for sale.

CRUCIFERAE. Mustard Family.

Herbs or rarely woody plants with acrid, watery juice; alternate leaves without stipules; flowers in racemose or corymbose clusters, cruciform of 4 deciduous sepals and 4 petals, placed opposite each other in pairs, spreading and forming a cross; stamens 6, 2 shorter; 1 pistil, consisting of 2 united carpels; fruit a pod either much longer than broad (silique), or short (silicle), or in-

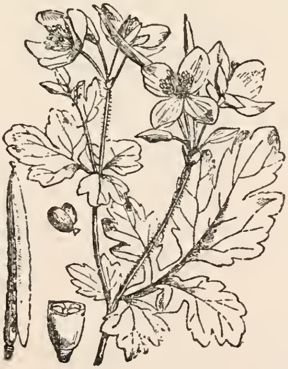


Fig. 254. Common Celandine (*Chelidonium majus*). Poisonous to the skin. (After Fitch).

dehiscent, separating into joints; seeds without endosperm; seed coat frequently mucilaginous; embryo large. About 1500 species of wide distribution.

The cabbage (*Brassica oleracea*), native to Europe, has long been cultivated; cauliflower, brocoli, and brussels sprouts also belong to the same species. Rape, a well known forage plant, the turnip, the Swedish turnip, and rutabaga (*B. campestris*) are native to Europe. The Chinese cabbage (*B. Pe-Tsai*) is commonly cultivated in China. Black mustard (*B. nigra*) and white mustard (*B. alba*) are extensively cultivated for their seeds, which when ground make the commercial mustard. The radish (*Raphanus sativus*), cultivated for the root, is native to Europe. Water cress (*Radicula nasturtium-aquaticum*) is much used as a salad plant in colder regions. Horse radish (*R. Armoracia*) the well known condiment is native to Europe. European pepper grass (*Lepidium sativum*) is cultivated as a salad plant, while the seeds of our pepper grasses (*Lepidium apetalum* and *L. virginicum*) are used as bird food. Seakale (*Crambe maritima*), native to Europe, has also been introduced into this country as a vegetable. The *Pringlea antiscorbutica* of Kuerguelen's Land resembles the common cabbage and is used by sailors as a vegetable when they touch that country. The Rose of Jericho (*Anastatica hierochuntica*) of North America and Syria is regarded as sacred by the natives. Many plants of this family are cultivated for ornamental purposes; among the most familiar are the candytuft (*Iberis*), stock (*Matthiola incana*), sweet alyssum (*Alyssum maritimum*), and wall-flower (*Erysimum asperum*). Dyer's woad (*Isatis tinctoria*) of China was formerly cultivated for a dye obtained from the leaves. The characteristic odor of plants of this order when crushed or when mustard seed is ground in water is due to an enzyme *myrosin,* discovered by Bussey in 1839. This same ferment occurs in the families *Cruciferae, Capparidaceae, Resedaceae, Tropaeolaceae, Limnanthaceae, Papaveraceae.*

It occurs in special cells known as myrosin cells which give a marked protein reaction. The contents are finely granular, free from starch, chlorophyll, fatty matter, and aleurone grains. These cells become red with Millon's reagent, and when heated become orange red, and a violet red color when treated with copper sulphate and caustic potash. The subjcet is treated fully by Reynolds Green in his work on "The Soluble Ferments and Fermentation," and in Effront and Prescott's "Enzymes and their Applications."

Some of the European plants of the family like (*Erysimum crepidifolium*) cause staggering in animals. The *Cheiranthus Cheiri* contains a glucoside which acts on the heart. Rape under some conditions is poisonous. Several correspondents in Breeders' Gazette (Chicago) have ascribed poisoning where rape was frozen, or when the plants were wet with dew.

Genera of *Cruciferae*

Pod terete or turgid or 4-angled.
  Pod obovoid; flowers yellow ....5. Camelina
Pod linear or oblong.
    Cotyledons accumbent.
      Pod short; flowers yellow or white..................3. Radicula
    Cotyledons incumbent.
      Pod angled or terete; flowers yellow or white.....1. Sisymbrium
    Cotyledons conduplicate; flowers yellow or white..........2. Brassica

Pod short.
  Pod many or few seeded; obcordate-triangular.
    Pod many seeded, obcordate-triangular..................4 Capsella
    Pod few seeded, orbicular, obovate or obcordate........7 Thlaspi
    Pod 2-seeded, flat, notched ....6 Lepidium

1. *Sisymbrum* (Tourn.) L.

Annual or biennial herbs with usually simple spreading pubescent, hairs occasionally forked or stellate; leaves entire, oblanceolate, divided, pinnatifid, or runcinate; flowers in racemes; calyx open, greenish, of 4 sepals; corolla white, yellow or yellowish, or rarely pink, small; pistils terete, flattish or 4-6-sided; small entire stigma; seeds small oblong; cotyledons incumbent.

A small genus of 60 species. Found in temperate regions of both hemispheres. Several species are well known troublesome weeds.

Sisymbrium officinale Scop. Common Hedge Mustard

A slender erect annual or winter annual, 1½-2½ feet high; lower leaves divided, runcinate, pinnatifid, upper entire or hastate at base; flowers small, yellow, borne in spike-like racemes; seeds small, brown; cotyledons incumbent.

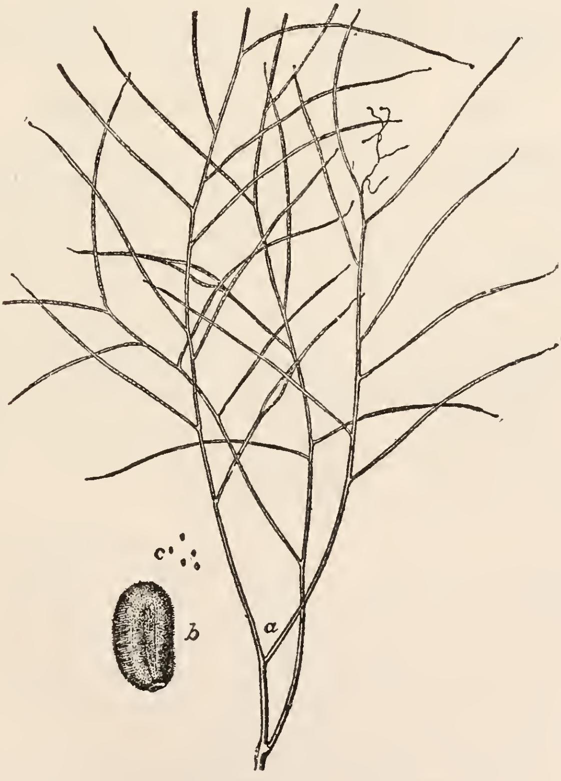


Fig. 255. Tumbling Mustard (*Sisymbrium altissimum*). Common in Canada and from Minnesota to Washington. (Dewey, U. S. Dept. Agrl.)

Distribution. A very common weed along railroads, door yards, and fields from Canada south to Florida and west to Illinois, Wisconsin, Minnesota, Missouri, Dakotas, Nebraska and Kansas, and Pacific North coast. Common hedge mustard is a naturalized weed from Europe. It occurs throughout Europe, Russia, Germany, Great Britain, France—except Northern Scandinavia.

Sisymbrium atlssimum L. Tumbling Mustard

An erect, much branched annual from 1-4 feet high, lower leaves runcinate pinnatifid, irregular toothed or wavy margined; upper leaves smaller, thread-like; after flowering, leaves drop, leaving the stem and pods; flowers pale yellow, rather large; sepals 4, green; corolla of pale yellow petals; pods narrowly linear, divergent; seeds small, longer than broad, generaly oblong in outline with rather blunt ends; radicle usually very prominent and straight, curved spirally around the cotyledons.

Distribution. This weed has spread with considerable rapidity in the Northwest. Dr. Robinson states that it was once scarcely more than a ballast weed about the large cities of the Atlantic seaboard, and records its occurrence sparingly in southern Missouri (Bush). It is common now, however, from the Mississippi Valley northwest to the Pacific Coast. One of the most common weeds of Montana, Idaho, Eastern Washington, Oregon, and native to British Columbia. Found also along the Atlantic seaboard.

Poisonous properties. This plant has properties somewhat similar to those described for Mustard; therefore may produce deep ulcers which are difficult to heal.

Brassica (Tourn.) L. Mustard, Turnip, Rape

Annual or biennial branching herbs, basal leaves pinnatifid, flowers yellow, racemose, pods elongated nearly terete or 4 sided; seeds spherical, 1 row in each cell; cotyledons conduplicate. About 85 species of Europe, Asia, and North Africa, introduced in North and South America, Australia. The black mustard (*B. nigra*) and charlock (*B. arvensis*) common in grain fields and waste places across the continent.

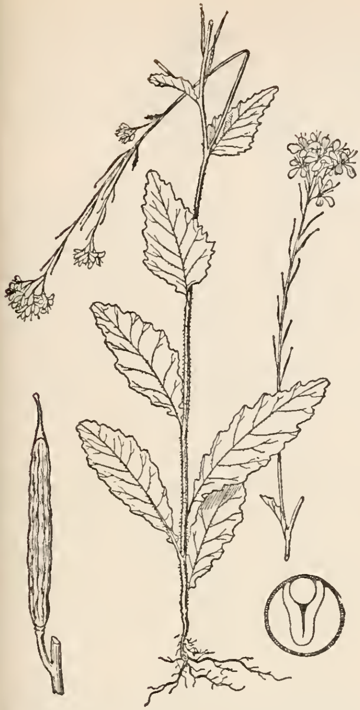
Brassica nigra Koch. Black Mustard

A tall, coarse, much branched annual, 2-5 feet high: hairy or smoothish, somewhat bristly, at least on the veins; leaves variously divided or deeply cut, and sharp toothed;—large terminal lobe; the upper leaves small, simple, usually linear; flowers yellow, smaller than in charlock; pods smooth, about ½ inch long, 4-cornered, tipped with a slender beak; seeds black or reddish brown, smaller than in charlock; cotyledons conduplicate.

Brassica arvensis (L.) Ktze. Mustard or English Charlock

Branching annual from 1-3 feet high, hispid or glabrate; lower leaves petioled with 1 large terminal lobe, and several small lateral lobes, with the divisions unequal; upper leaves barely toothed; flowers yellow, large and very fragrant; pods 1-2 inches long, irregular in outline, appearing somewhat nodose, 3-7 seeded, or more occasionally; the upper part of pod forms the beak; seeds round, brownish black, darker than in *B. nigra*, and more minutely pitted. When moistened, the seeds become mucilaginous.

Distribution. It is a common and troublesome weed in cultivated ground from Mass. to Oregon. The most troublesome weed in grain fields of the Northwest.



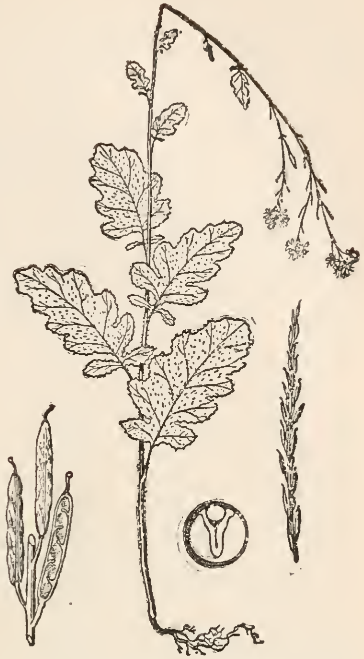


Fig 256. Charlock (*Brassica arvensis*). U. S. Dept. Agrl. Fig. 256a. Common Black Mustard (*Brassica nigra*). U. S. Dept. Agrl.

Medicinal and Poisonous properties. White mustard contains a glucoside also found in other members of the family *sinalbin,* $C_{30}H_{42}N_2S_2O_{15}+H_2O$, and in addition, the ferment known as *myrosin* which converts the *sinalbin* into an active principle, *oxy-benzyl-thiocyanate* (a very acrid volatile body) *sinapin sulphate* and *glucose.* The following formula represents the change that occurs:

$$C_{30}H_{44}N_2S_2O_{16}=C_6H_{12}O_6+C_7H_7O\text{-}NCS+C_{16}H_{24}NO_5\text{-}HSO_4.$$

Sinalbin — Glucose — Oxy-benzyl-thiocyanate — Sinapin sulphate

Black mustard contains the glucoside *sinigrin,* and a ferment, *myrosin,* which produces the following reaction:

$$C_{10}H_{18}NKS_2O_{10} = C_3H_5CNS + C_6H_{12}O_6 + KHSO_4.$$

Sinigrin — Sulpho-cyanate of allyl (Essential oil of Mustard) — Glucose — Hydrogen Potassium sulphate

White Mustard seed when reduced to a powder and made into a paste with cold water, acts as a powerful stimulant. Large doses cause vomiting. Intestinal secretion is increased by the use of mustard, which is rarely used, however, as an emetic because of its pungency. It is extremely valuable for relieving pain or congestion. It is a splendid emetic for dogs in the spoonful doses, given in warm water. Dr. Millspaugh states that in the case of black mustard, no specific toxic symptoms have been noted, but in speaking of white mustard, he states that the essential oil of mustard is a virulent, irritant poison, causing, when ingested, severe burning, followed by increased heart action, and if pushed to extremes, loss of sensibility, paralysis, stupor, rigors, and death. It causes immediate vesication, followed by deep ulceration, which is difficult to heal.

Dr. White in his Dermatitis Venenata, says:

> The action of the sinapism is well known. In a few minutes after its application the skin begins to feel warm, and by the end of a half-hour, if the patient bear it so long, this sensation has increased to an intolerable burning. The changes in the cutaneous tissue are, within a few minutes, a considerable degree of hyperaemia, which, after a time, increases to an intense redness, which persists for a day or two, and often leaves behind it a persistent pigmentation, at times of a dark brown color, to mark the seat of the sinapism. On this account one should never be applied upon the upper chest or other part of a woman which the dress will not always conceal. If the action be continued beyond its legitimate rubefacient effect, a period which varies greatly in persons, it may produce vesication, or even deep suppuration, effects at times very intractable under treatment. It is stated that the addition of vinegar to a mustard poultice greatly lessens its activity.

Sarepta mustard (*B. Besseriana*) much resembles black mustard and is used in the same way. Sarson or Indian colza (*B. campestris* var. *Sarson*) is used in India in place of white mustard and oil cakes made from it serve as stock food. A brown variety (*B. Napus* var. *dichotoma*) is grown both as an oil seed and as a vegetable. Another variety, Indian mustard (*B. juncea*) is also known as of economic importance.

The mustards of India are not always easy to distinguish. They have been carefully studied by Col. Prain.

Brassica Rapa causes inflammation of the bowels, tympanites, constipation, diarrhoea, some brain irritation, and haemorrhagic enteritis. The disease is more common in Europe where rape seed is used as stock food.

3. *Radicula* (Dill.) Hill

Annual, biennial or perennial, usually glabrous herbs of pungent qualities, pinnate, entire, or pinnatifid leaves; flowers yellow or white; calyx with spreading sepals; pistil with short or slender style and 2-lobed, or entire stigmas; pod usually short, varying from oblong-linear to globular-terete; seeds numerous, small in 2 rows in each cell; cotyledons accumbent. About 25 species of wide distribution.

Radicula Armoracia (L.) Robinson. Horse radish

A stout perennial with long deep roots; leaves large, on thick petioles, oblong, crenate, or pinnatifid, glabrous; stem leaves lanceolate, or oblong cordate; flowers with 4 green sepals and 4 white petals, not common; pods short, globular, but fruit seldom found.

Distribution. It is native to the eastern part of Europe, Turkey, Greece, and the Caspian Sea through Russia, Poland and Finland. In Germany, France, Sicily, Norway, and Great Britain, it has escaped from cultivation. Common in Northern United States.

Radicula palustris (L.) Moench, var. *hispida* (Desv.) Robinson. Marsh Cress.

An erect annual, or biennial, pubescent herb, from 1-2½ feet high; leaves pinnately cleft or parted, or occasionally the upper laciniate; the lobes toothed;

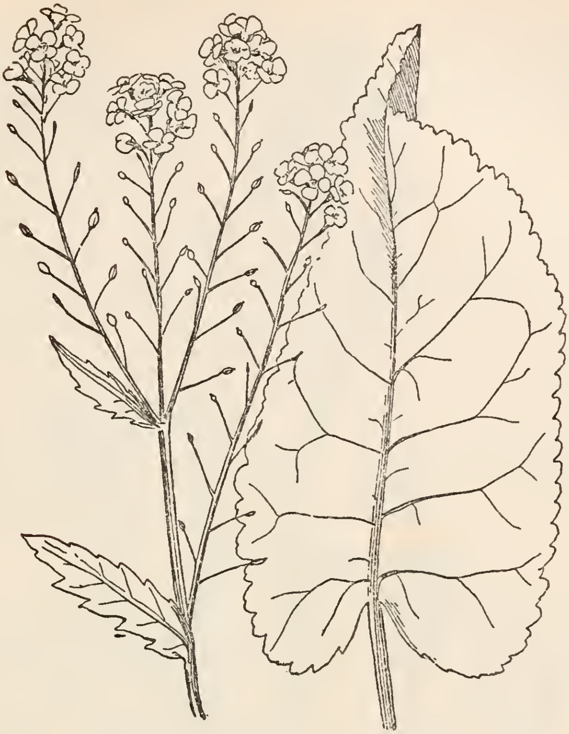


Fig. 256b. Horse radish. (C. M. King).

upper leaves nearly sessile; pedicels as long as the small flowers, generally longer than the pods; pods ovoid or oblong; styles short.

Distribution. Common in northern portions of United States, to the Gulf and west to the coast; also Canada. Native to Europe.

Medical and poisonous properties. It is certain that horse radish and other members of this genus have properties somewhat similar to those of the mustards mentioned above. Horse radish contains both *sinigrin* and *myrosin.* Dr. Rusby mentions that it may produce serious trouble. He says:

> The common horse radish, likewise, loses its irritating properties when heated or dried. These are almost identical with those of mustard, and while it would not generally be regarded as a poisonous article, yet used in excess it may become so through its powerful irritation of the urinary organs, by which it is excreted. Johnson gives a case in which this result was extreme and serious. It may therefore be borne in mind that it should not be consumed in inordinate quantity. This result, should it occur, would be found excruciatingly painful.

Dr. Johnson in his Manual of Medical Botany of North America, writes as follows:

> The acrid principles of these plants appear, clinically, to be eliminated by the kidneys, and hence, incidentally, they produce a decided diuretic effect. The urine is not only increased in quantity, but partakes also of the acrid character of the plant employed. In one case that came under the author's observation, the individual, though in perfect health, so far as the genito-urinary tract was concerned, suffered extremely from vesical pain and irritation for hours after using horse-radish as a condiment. In animals it produces a violent colic.

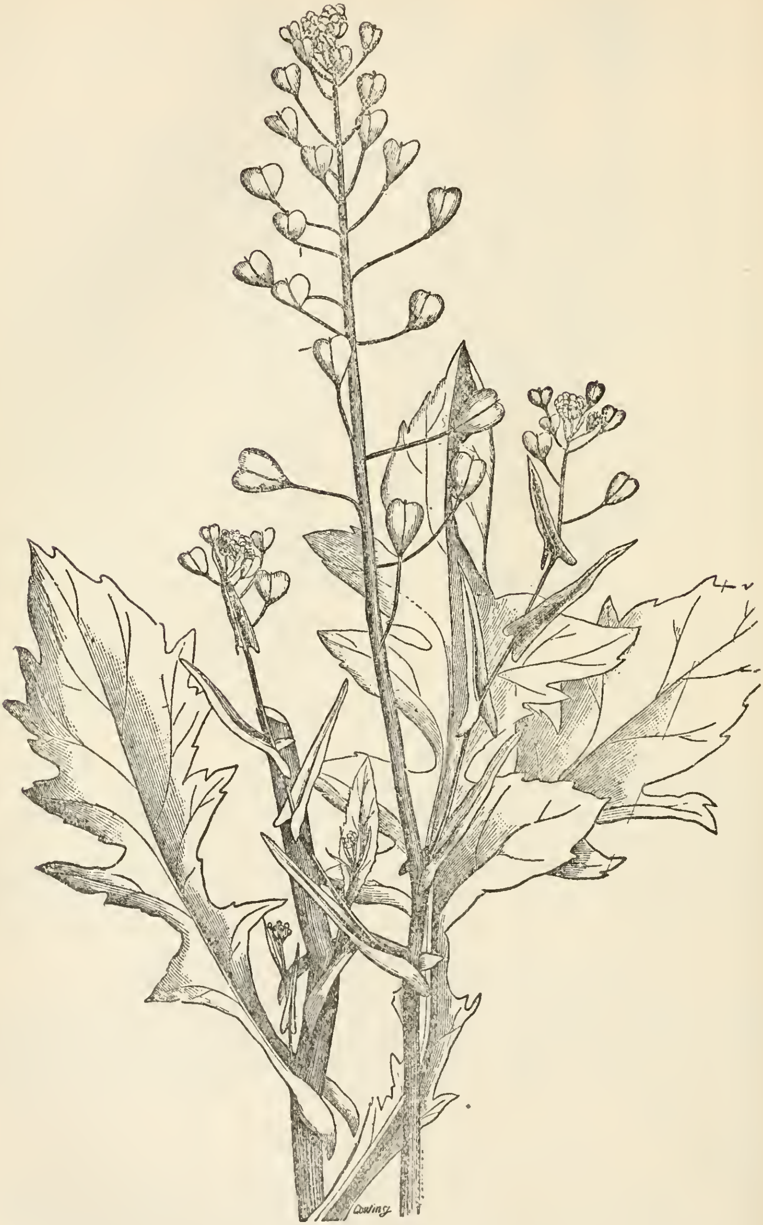


Fig. 256c. Shepherd's Purse (*Capsella Bursapastoris*). U. S. Dept. Agrl.

4. *Capsella,* Medic. Shepherd's Purse

Annual or winter annual, erect herbs, pubescent with more or less branched hairs; flowers in racemes, small, white; basal leaves tufted; pistils with short styles; pods obcordate, triangular, compressed at right angles to the partition; valves boat-shaped; seeds numerous, small, without margins; cotyledons accumbent. A small genus of 4 species, 2 in North America.

Caspella Bursa-pastoris (L.) Medic. Shepherd's Purse

An annual or winter annual, 1½ feet high, root leaves clustered, lobed, pinnatifid, or merely toothed, stem leaves sessile, lanceolate, auricled; flowers small, white; pods triangular, truncate, or emarginate, many seeded; seeds light brown, elongated with a prominent ridge; seeds mucilaginous when moistened with water; cotyledons incumbent.

Distribution. One of the most common weeds everywhere in eastern North America from Nova Scotia to Florida, west to Texas and the Pacific Coast, from Eastern Canada to Manitoba to Vancouver in B. C. Cosmopolitan, as common in Europe as in the United States. Naturalized from Europe.

Poisonous properties. It produces the same symptoms as other members of the family only somewhat less severe.

5. *Camelina, Crantz.* False Flax

Erect, annual herbs, sparingly branched; leaves entire, lanceolate, or pinnatifid; flowers racemose, yellow; sepals 4, green; petals 4, yellow small; pistil with stigma entire, style slender; pod obovoid or pear-shaped; flattish; seeds small, numerous; cotyledons incumbent. The 5 species are native to Europe and Asia.

Camelina sativa (L.) Crantz. False Flax

An erect, glabrous annual with simple or sparingly branched stem, 1½ feet long, smooth, or slightly pubescent, hairs stellate; leaves erect, lanceolate or arrow shaped, entire or nearly so; flowers small, yellow, pedicels in fruit spreading; pod obovoid or pyriform, smooth reticulated, margined; seeds light brown 1 line long, minutely pitted, cotyledons incumbent, caulicle prominent, running lengthwise. On the addition of water, the seeds become mucilaginous.

Distribution. It is common in Manitoba, south to Minnesota, Northern Iowa, and the Dakotas, where it is a well known and a troublesome weed, in flax and grain fields from Ontario to the Middle States across the continent.

Poisonous properties. The plant has a disagreeable sharp odor and causes counter-irritation.

6. *Lepidium* (Tourn) L. Pepper Grass

Erect or diffuse, annual, biennial or perennial herbs; leaves entire, or pinnatifid; flowers racemose, white; petals small or none; stamens 6 or fewer; pod roundish, flattened contrary to the partition, winged or wingless; seeds solitary in each cell; cotyledons incumbent or rarely accumbent. About 65 species in temperate regions. The European *L. campestre,* native to Europe cultivated for salad purposes, is occasionally spontaneous. The seeds of two of our native species are used for bird food.

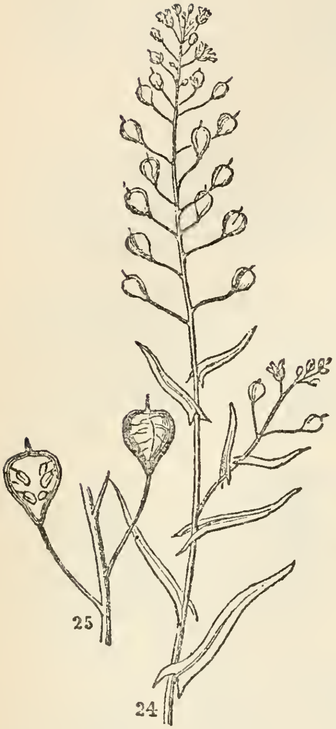


Fig. 256c. False Flax (*Camelina sativa*). Seeds become mucilaginous on addition of water. (After Hochstein).

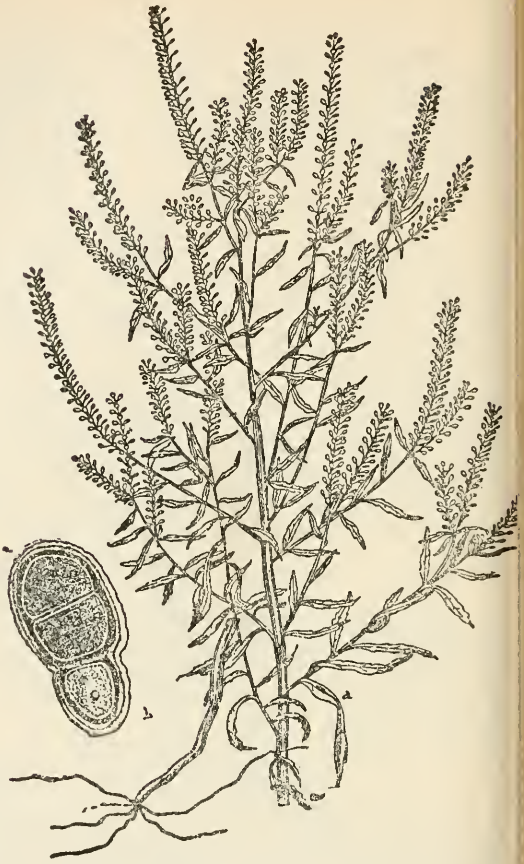


Fig. 257. Small Pepper-grass (*Lepidium apetalum*). Causes sinapism. (Charlotte M. King.)

Lepidium virginicum L. Large Pepper Grass

Pod circular or oval with a little notch at the upper end; seeds light brown, elongated, with a prominent ridge on one side, on the addition of water they become mucilaginous; cotyledons accumbent.

Lepidium apetalum Willd. Small Pepper Grass

Seeds light brown, elongated, with a prominent ridge on one side. Seeds become mucilaginous when moistened with water. Cotyledons incumbent.

Distribution. In nearly all parts of the United States.

Poisonous properties. Pepper grass produces counter-irritation.

7. *Thlaspi* L. Field Pennycress

Low plants with undivided root leaves, stem leaves arrow-shaped and clasping; flowers small, whitish or purplish; pod orbicular, obovate or obcordate; seeds 2-8 in each cell; cotyledons, accumbent.

Thlaspi arvense, Field pennycress, Frenchweed or Stinkweed

A smooth annual with small white flowers; pod, broadly winged, about ½ inch in diameter, deeply notched at top. Commonly naturalized in some places; becoming more abundant in the Northwest. A common weed in grain fields. It is common in the Canadian Northwest and not infrequent in Iowa and Minnesota, abundant in the Dakotas.

Poisonous properties. Probably causes counter-irritation. In the Canadian Rockies the weed is carefully avoided by stock because of its pungent properties.

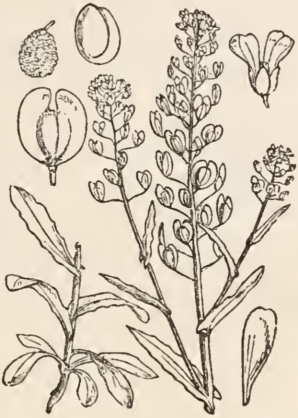


Fig. 258. Field Pennycress (*Thlaspi arvense*). (After Fitch).

Capparidaceae. Caper Family

Herbs, shrubs or, occasionally, trees; alternate leaves and cruciform flowers; sepals 4-8; petals 4 or none; stamens 6-numerous, not tetradynamous; fruit a 1-celled pod or berry with 2 parietal placentae; seeds similar to those of the *Cruciferae,* but with the embryo coiled. An order of about 35 genera and 400 species. Generally found in warm regions, few in the United States. The plants are often acrid or pungent; the flower-buds of one, the Caper (*Capparis spinosa*), are pickled. Several of the species like the Rocky Mountain bee plant are cultivated for ornamental purposes. A few of the plants are weedy.

Capparis contains the coloring matter *rutin.*

Genera of *Capparidaceae*

Plants clammy pubescent.
    Stamens 8 or more..2 Polanisia
Plants not clammy pubescent.
    Stamens 6, pod few seeded.................................3 Cleomella
    Stamens 6, pod many seeded................................1 Cleome

1. *Cleome* L.

Glabrous annuals; leaves trifoliolate or simple; flowers in leafy bracted racemes; petals entire, with claws; stamens 6; pistil with a 1-celled ovary;

pod linear with a long stalk (stipe) many seeded; the receptacle bearing a gland beyond the stipitate ovary. A small genus of about 75 species, mainly tropical.

Cleome serrulata Pursh. Rocky Mountain Bee Plant

An annual, from 1-3 feet high, with digitate, 3-foliolate leaves and leafy, bracteate racemes; calyx 4-cleft, petals 4, cruciform, short clawed, and rose-colored; pods linear, many seeded.

Distribution. Widely distributed west of Missouri, from the Canadian Rockies to Kansas, Mexico, Arizona and Utah, eastward occasionally from Minnesota to Illinois. The plant is regarded with great favor as a bee plant.

Cleome lutea Hook. Yellow Cleome

This plant is like the preceding, but the leaves are 5-foliolate or the upper 3-foliolate, leaflets oblong or oblong-lanceolate, entire, stalked or sessile; flowers yellow; pod linear, stipe longer than the pedicel.

Distribution. In dry soil from Nebraska to Washington and Arizona. The former species is particularly conspicuous west of the 100th meridian.

Poisonous and Medical properties. These plants are not generally placed with the poisonous plants, although they contain the same pungent principles that members of the Mustard family have. They are seldom eaten by stock.

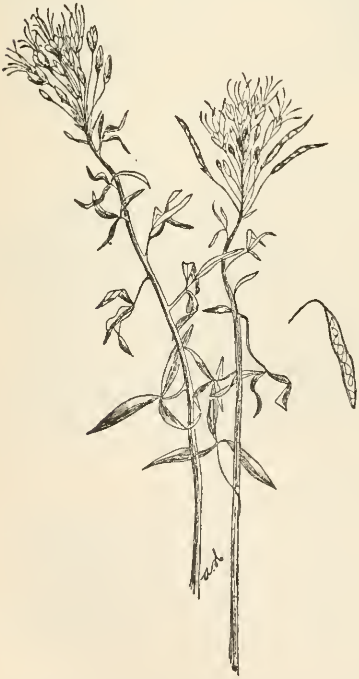


Fig. 259. Rocky Mountain Bee Plant (*Cleome serrulata*). A plant with pungent properties. (Ada Hayden).

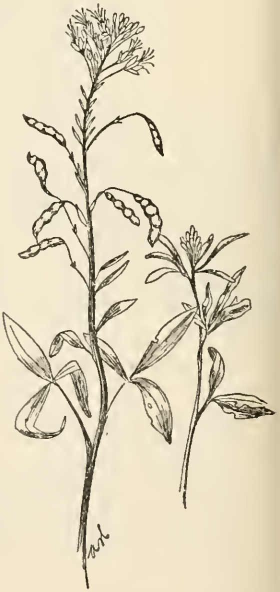


Fig. 260. Yellow Cleome (*Cleome lutea*). Common in the West. (Ada Hayden).

2. *Polanisia* Raf.

Clammy herbs with whitish or yellowish flowers, palmately compound or simple leaves; flowers produced in racemes; sepals 4, deciduous; petals with claws and notched at the apex; receptacle not elongated, bearing a gland at the base of the ovary; stamens 8-numerous, unequal; pod linear or oblong, turgid, many-seeded, seeds reticulated. About 14 species in tropical and temperate regions. Annuals, with glandular hairs; common in sandy soils or on railroad embankments.

Polanisia graveolens Raf. Clammy-weed

The near relative of the Rocky Mountain bee plant is a clammy weed with loose racemes of conspicuous flowers; petals with claws; stamens 8-32; pod linear or oblong, turgid, many-seeded.

Poisonous properties. The same may be said of this as of *Cleome.* It is a clammy, pubescent weed with very pungent properties.

3. *Cleomella* DC.

Annual herbs with 3-5 foliolate leaves, calyx of 4 sepals; flowers generally in racemes; petals 4, entire, without claws; receptacle short; stamens 6, inserted on the receptacle; ovary short, long-stalked; pod linear to oblong, many-seeded. About 75 species, found chiefly in southwestern North America and Mexico.

Cleomella angustifolia Torr

A glabrous annual from 1-2 feet high, leaflets 3, linear lanceolate or linear oblong, bracts simple; flowers small, yellow; pod rhomboidal, raised on a slender stipe, but shorter than the pedicel, few seeded.

Distribution. From Nebraska and Kansas to Texas, New Mexico and Colorado. Abundant in waste places.

SARRACENIALES

Carnivorous plants secreting a viscid liquid; radical leaves; scapose flowers; corolla choripetalous; sepals generally distinct; stamens usually free; ovary compound superior. Contains the families *Droseraceae, Sarraceniaceae* and *Nepenthaceae*; the genus *Sarracenia* has 6 species in eastern North America; *S. purpurea*, found as far west as Minnesota, contains the alkaloid *Sarracenin. Darlingtonia californica* occurs in California and Oregon. *Heliamphora* is native to Guiana. The family *Nepenthaceae* with 40 species is found mostly in the India-Malayan regions; some species being frequently cultivated in greenhouses. The plants of these orders are insectivorous, capable of digesting insects.

DROSERACEAE

Perennial or biennial glandular pubescent bog herbs or somewhat shrubby plants; leaves mostly from the base with tentacles, which secrete a viscid substance to catch insects; circinnate in the bud; flowers perfect, racemose; calyx persistent, 4-8 parted, or the sepals distinct; petals 5 free; stamens 8-20; ovary free, 1-3-celled; styles 1-5, simple 2-cleft; capsule 1-5-celled. A small order of 125 species of wide distribution. The most important genus is *Drosera*, commonly called sundew, the tentacles of which secrete a viscid fluid which catches

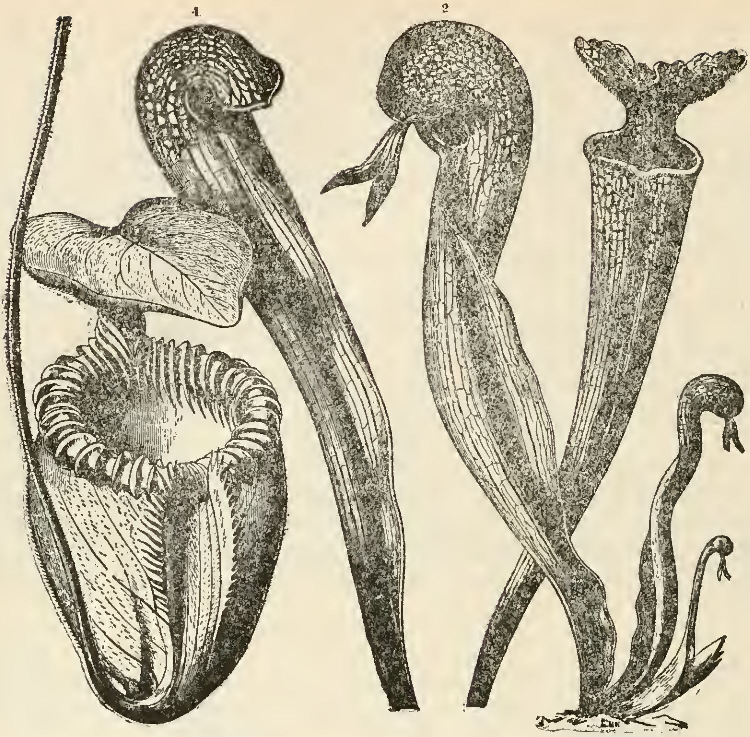


Fig. 260a. Various insectivorous plants: 1, *Sarracenia variolaris*; 2, *Darlingtonia californica*; 3, *Sarracenia laciniata*; 4, *Nepenthes villosa.*

insects and clings to them. The *D. rotundifolia* is commonly found in our northern bogs. The *Drosophyllum lusitanicum* is found on the sandy hills of Portugal. The Venus fly-trap (*Dionaea muscipula*) of the Carolinas grows on the sandy barrens and feeds on insects. These plants are somewhat rare.

Poisonous properties. According to Dr. Schaffner, the common sundew is poisonous to cattle. From one species of *Drosera* two pigments have been isolated, the red having the formula $C_{11}H_8O_5$ and the yellow, $C_{11}H_8O_4$. Plants of the family in Australia are said to be poisonous to sheep.

According to Greshoff the leaves of *Drosera binata* contain hydrocyanic acid. *D. rotundifolia*, and *D. intermedia*, were also found to contain a little HCN. The leaves of *Dionaea muscipula* contain the same substance.

ROSALES

Herbs, shrubs or trees; flowers usually polypetalous; stamens mostly perigynous or epigynous; sepals chiefly united or confluent with receptacle; carpels 1 or more, distinct or sometimes united into a compound ovary. The order includes the families *Podostemonaceae, Crassulaceae, Cephalotaceae, Saxifragaceae, Pittosporaceae, Hamamelidaceae, Platanaceae, Rosaceae, Connaraceae, Leguminosae* and other small families. The family *Saxifragaceae* includes the red currant (*Ribes vulgare*), black currant (*R. nigrum*), the Missouri currant,

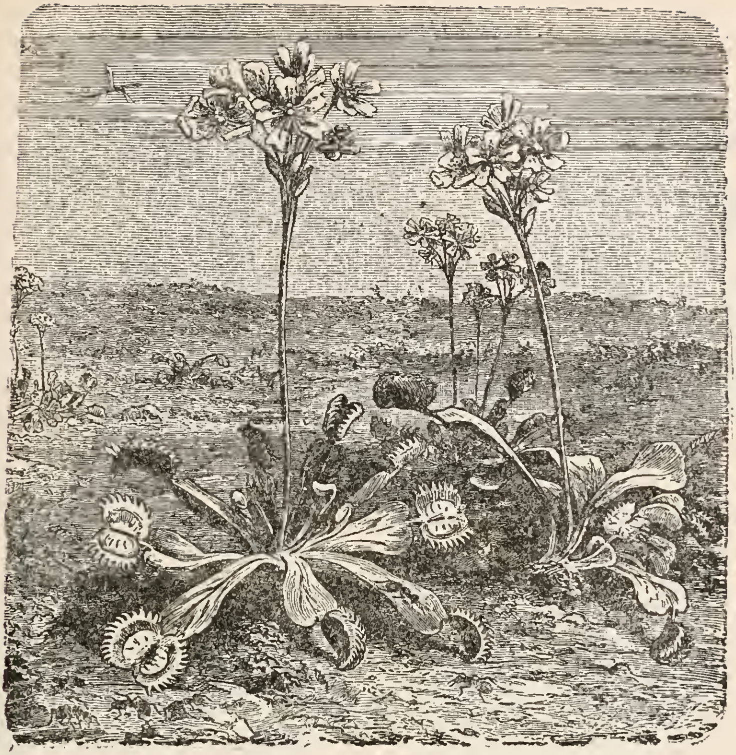


Fig. 260b. The Venus Fly Trap (*Dionaea muscipula*) showing the rosette arrangement and with some of the traps closed and others opened to catch the insects. (Kerner-Oliver, Dept. Ent. Univ. of Minn.).

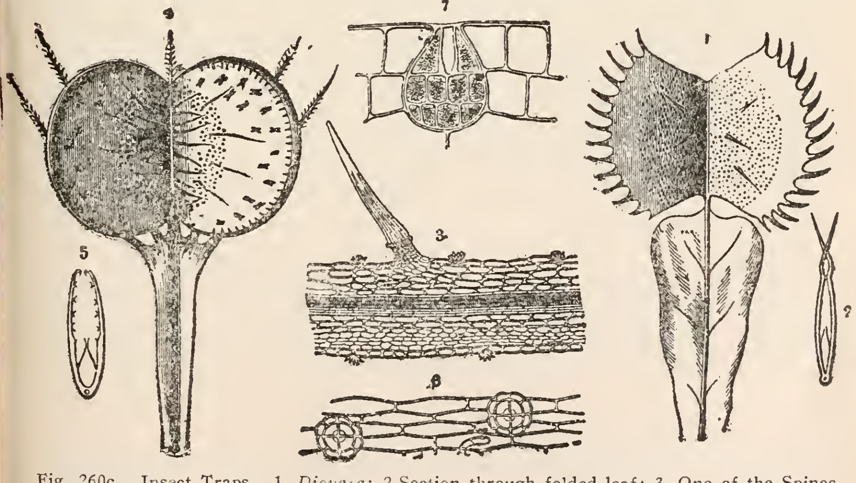


Fig. 260c. Insect Traps. 1, *Dionaea*; 2, Section through folded leaf; 3, One of the Spines. 4, Leaf of *Aldrovanda*; 5, Section of closed leaf; 6, Glands upon trap; 7, Glands in the wall of trap of *Sarracenia*. (Kerner. Dept. Ent. Univ. of Minn.).

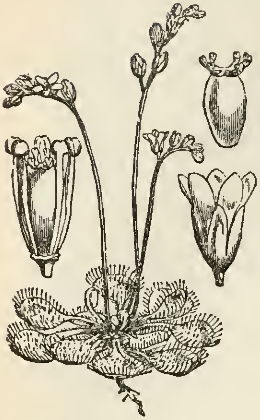


Fig. 261. Common Sundew (*Drosera rotundiflora*). Poisonous to cattle. (After Fitch).

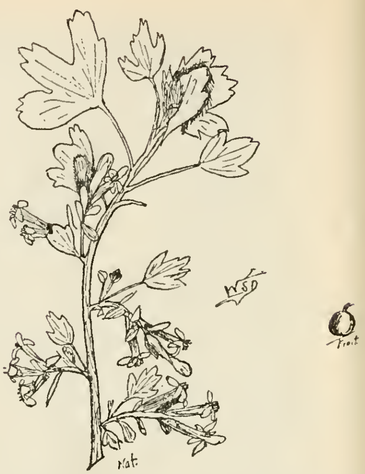


Fig. 262. Missouri Currant (*Ribes aureum*). The flowers are spicy fragrant. It is a well known shrub. (W. S. Dudgeon).

(*R. aureum*), the Crandall, a well known cultivated form; the cultivated gooseberry (*R. Grossularia*), Missouri gooseberry (*R. gracile*); the cultivated hydrangeas (*Hydrangea paniculata*); the wild hydrangea (*H. arborescens*); used as a diuretic; the mock orange (*Philadelphus coronarius*), and *P. grandi florus; Deutzia scabra,* the *Astilbe japonica* and the alum root (*Heuchera americana*) a powerful astringent. Several members of this family are poisonous; the western *Jamesia americana,* a pretty shrub of the Rocky Mountains with white flowers, contains an appreciable amount of HCN, according to Greshoff. The same substance also occurs in the garden *Hydrangea hortensia, H. arborescens,* an American species of the southern region. The *H. Thunbergii*; *H. Lindleyana* and *H. involucrata* all contain HCN. The HCN, however, is in a transitory stage. Greshoff states that the leaves of *Philadelphus coronarius, P. Lemoinei* and *P. microphyllus,* and the seeds of *P. grandiflorus* contain saponin, as do the leaves of *Deutzia staminea.* The family *Hamamelidaceae* includes the witch hazel (*Hamamelis virginiana*) containing a bitter principle; the storax (*Liquidambar orientalis*) of the Old World which contains two resin alcohols, *storesin* and *ester,* and red gum (*L. Styraciflua*) a common tree of moist woods of the South supplying a well known commercial wood; it is also an ornamental tree, the leaves of which, when bruised, are fragrant. The family *Platanaceae* contains the sycamore (*Platanus occidentalis*), a large tree which furnishes valuable wood and is also used for ornamental purposes. According to Greshoff the leaves of *Platanus acerifolia, P. cuneata, P. occidentalis* and *P. orientalis* contain HCN. The young leaves are poisonous.

Families of *Rosales*

Calyx free from the ovary, wholly superior.
  Simple 1-celled ....Leguminosae.
  Ovaries 2 or more compound; stamens twice as many as the pistils
  ....Crassulaceae.

Stamens inserted on the calyx, stipulate........................Rosaceae
Calyx more or less coherent with the compound ovary......Rosaceae (Pomeae)

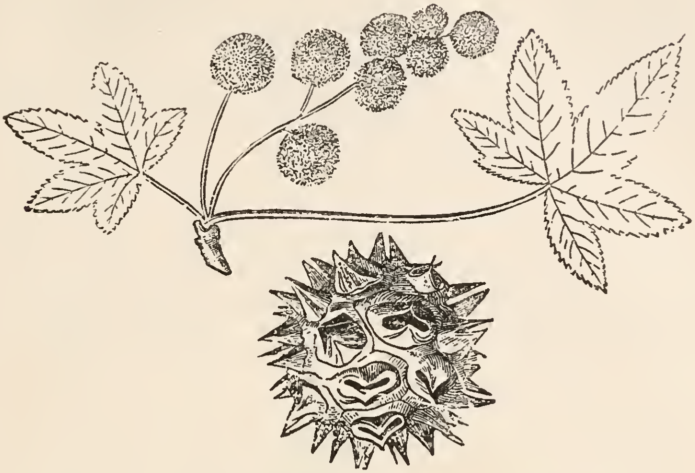


Fig. 251. Red Gum (*Liquidamber Styraciflua*). Furnishes a commercial wood.

CRASSULACEAE DC. Orpine Family

Succulent herbs; leaves generally sessile without stipules; flowers small, symmetrical, usually cymose; petals and sepals equal in number, from 3-20; stamens as many or twice the number; pistils distinct, fewer than the sepals; receptacle usually with small scales 1 back of each carpel; fruit a dry dehiscent follicle; usually many seeded. This is a small family of about 50 species, many being found in dry soils, rocks, etc. in North Temperate regions. A few of the species are cultivated for ornamental purposes, among these being the *Rochea coccinea* of the Cape of Good Hope, whose flowers have narcotic properties; poisoning sometimes resulting from smelling them. Some of the *Crassulaceae* contain *crassulacic* and *malic acids.* The *Cotyledon ventricosa* of South Africa is said to produce the Nenta disease of that region, although this is usually ascribed to some members of the Pulse family and is probably identical with loco disease. The leaves of wild tea (*Catha edulis*), according to Bull. Miscellaneous Information of Kew Gardens, when chewed are said to have great sustaining powers.

Sedum (Tourn.) L. Stone Crop

Fleshy, smooth herbs, mostly perennials, with alternate leaves; flowers cymose, perfect or dioecious; calyx 4-5-lobed; petals 4-5, distinct; stamens 8-10, perigynous; pistils 4-5, distinct or united at the base; styles short; follicles many-seeded. About 150 species, mostly of temperate and cooler regions of the northern hemisphere. A few are cultivated for ornamental purposes. There are several somewhat weedy species as *S. purpureum* and mossy stone crop (*S. acre*), the latter native to Europe but escaped to roadsides in the East. It has acrid properties, which is also true of the live-forever, a plant of the Rocky Mountains.

Sedum purpureum Tausch. Live-forever

A stout perennial 2 feet high with fleshy oval or obtuse, toothed leaves; and flowers in compound cymes; corolla purple, with oblong-lanceolate,, purple petals; stamens perigynous; pistils with a short style; fruit a follicle with a short pointed style.

Distribution. Native to Europe, frequently escaped from cultivation and found around dwellings and in cemeteries.

Sedum acre L. Mossy Stone Crop

A moss-like plant spreading on the ground; leaves small, alternate, ovate thick and fleshy; flowers yellow, perfect, in spike-like clusters, cymose; the central flower with 5 sepals, 5 petals, and 10 stamens, the others with 4 sepals, 4 petals and 8 stamens; follicle spreading, tipped with a slender style.

Distribution. On rocks and along roadsides from New Brunswick to New York and Pennsylvania. Native to Europe.

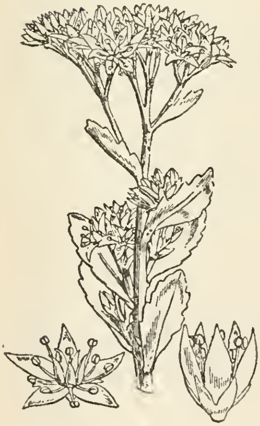


Fig. 263. Common Live-for-ever (*Sedum purpureum*). A plant with acrid properties. (Fitch).

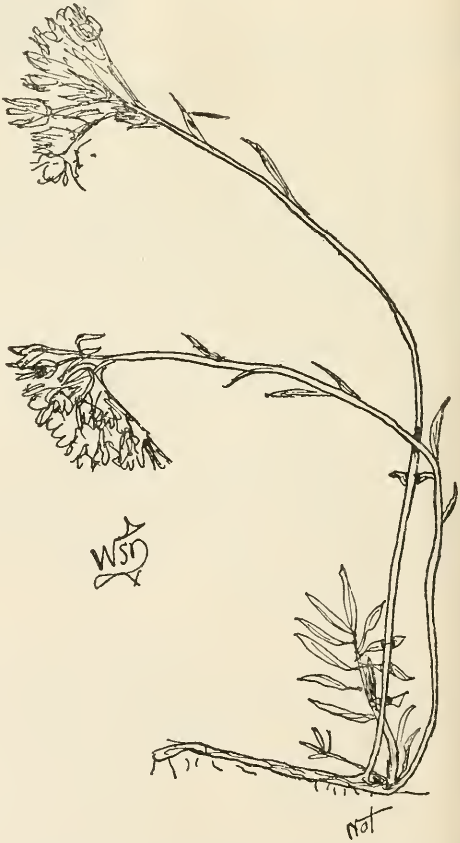


Fig. 264. Live Forever (*Sedum stenopetalum*). Common in the Rocky Mountains; a plant with acrid properties. (W. S. Dudgeon).

Poisonous properties. Sedum acre, according to Dr. Schaffner, produces inflammation and vesication when applied to the skin; it is used to remove the false membrane in diptheria. Dr. White, in his "Dermatitis Venenata," says with reference to the *Sedum acre*: "Wood states that the whole plant abounds in an acrid, biting juice. Oesterlen says that it is sharply irritative to the skin. The National Dispensatory states that the juice is capable of blistering the skin, and that it is used upon corns and warts to soften them, and upon swollen glands as a resolvent. Mr. Cheney, a wholesale dealer in vegetable drugs, informs me that the juice of the green plant is poisonous to the skin of many persons." This plant, however, is not common in the United States.

ROSACEAE. Rose Family

Herbs, shrubs, or trees; leaves alternate or some opposite, stipulate, frequently falling soon after the leaves appear; flowers regular; stamens generally numerous, distinct, inserted on the calyx; petals as many as the sepals or rarely wanting; pistils 1-many, generally distinct, except in Pomeae, where the pistil is united to the calyx; fruit various, achenes, follicles, drupes or pomes as in the apple; seeds 1-many, without albumen; embryo straight, with large cotyledons. The order contains about 90 genera and 1500 species of wide distribution; in temperate and tropical regions, some boreal. But few of the plants are noxious or have noxious qualities.

The several cherries, like *Prunus serotina* and *P. virginiana* are known to cause stock poisoning, and the seeds when eaten likewise produce fatal results in man. The *P. serotina* or wild black cherry, is used in medicine, under the name of *P. virginiana.* The choke cherry (*P. virginiana*) is also used in medicine. The bark of the wild black cherry is officinal. It contains tannic and gallic acids, and a volatile oil resembling the volatile oil of bitter almonds. It is used as a tonic and astringent. The leaves of the laurel cherry are used for making cherry laurel water which is a sedative narcotic. From *Prunus Amygdalus,* var. *amara,* native to Asia, is obtained the *amygdalin* of bitter almonds, which is converted into *hydrocyanic acid.* This acid is deadly poison, and is obtained from a great many different plants. The leaves of the laurel cherry also contain the same substance. HCN has been found in *Prunus paniculata, P. pendula, P. Pennsylvanica; Pyrus Aria, P. pinnatifida, P. japonica; Crataegus orientalis; Cotoneaster integerrima; Nuttallia cerasiformis; Amelanchier alnifolia; Chamameles japonica.* According to Greshoff the leaves of *Kageneckia angustifolia* contain hydrocyanic acid. The same writer reports this substance in the mountain mahogany (*Cercocarpus parvifolius*) of the Rocky Mountains. It must be regarded as poisonous. In laurel cherry, it is largely derived from the decomposition of *laurocerasin.* This species also contains *prulaurocerasin.* Several species of other orders also might suitably be mentioned here as containing substances capable of being converted into hydrocyanic acid. In this class are the toadstools (*Agaricus oreades*), bitter cassava (*Manihot utilissima*) and sorghum (*Andropogon Sorghum*).

According to Greshoff *Cornus foliolosa, Spiraea japonica* and many other plants of the family contain saponin.

The same substance is obtained from other plants of the genus *Prunus.* Oil of roses is obtained from the *Rosa damascena,* Miller, var. The mucilaginous seeds of the quince (*Pyrus Cydonia*) have been used in medicine for a long time.

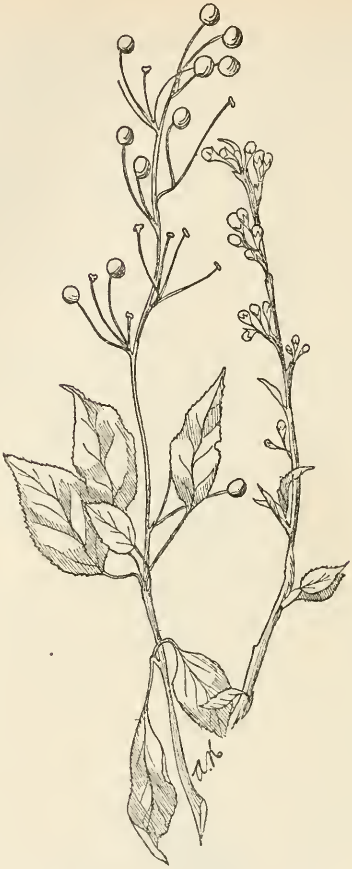


Fig. 265. Wild Red Cherry (*Prunus pennsylvanica*). It contains the glucoside *amygdalin*. (Ada Hayden).

Many plants of the family are cultivated for ornamental purposes and some are economic. In the first class is the laurel cherry (*Prunus Lauro-cerasus*), a handsome fragrant shrub of the Caucasus to northern Persia, cultivated in the southern states and very common in the Mediterranean regions of Europe. The Mayday tree of Europe (*Prunus Padus*), as well as numerous species of the genus *Spiraea*, like *Spiraea Douglasii, S. salicifolia, S. japonica, S. Thunbergii;* the nine-bark (*Physocarpus opulifolius*), species of the genus *Rosa*, such as the prairie rose (*Rosa setigera*), sweetbrier (*Rosa rubiginosa*), dog rose (*Rosa canina*), *R. rugosa, R. gallica,* and the cinnamon rose (*R. cinnamonea*) are frequently cultivated. *Kerria japonica, Rubus odoratus, Pyrus coronaria, P. japonica, P. Aucuparia, P. americana, Crataegus mollis* and *C. punctata* are also cultivated.

The family contains a large number of valuable fruits; of these we may mention the service berry (*Amelanchier canadensis* and *A. spicata*), the apple (*Pyrus Malus*), the pear (*Pyrus communis*), the quince (*P. Cydonia*), strawberry (*Fragaria vesca, F. virginiana*, var. *Illinoensis*), the *F. chiloensis*, native to Chili and the Pacific coast (the common garden strawberry is a modified form of the Chilian strawberry), and the Indian strawberry (*Duchesnea indica*). We may also mention the wild northern plum (*Prunus americana*), the Chickasaw plum (*P. angustifolia*), European garden plum (*P. domestica*), sand cherry (*P. pumila* and *P. Besseyi*) ; the cherries, English cherry (*P. avium*), naturalized in the southern states, especially in Virginia and Maryland, the sour cherry (*P. Cerasus*), also naturalized in the East and extensively cultivated, the wild red cherry (*P. pennsylvanica*), commonly used in the north, the Japanese plum (*P. triflora*), the apricot (*P. armeniaca*), peach (*P. persica*), almond (*P. Amygdalus*) flowering almond (*P. nana*), wild red raspberry (*Rubus idaeus* var. *aculeatissimus*), black raspberry (*R. occidentalis*), garden raspberry of Europe (*R. Idaeus*), salmon berry (*R. parviflorus*), dewberry (*R. cuneifolius*) and the wineberry of Japan (*R. phoenicolasius*). The fruit of the Icaco plum (*Chrysobolanus Icaco*) of tropical America is edible. The wood of the wild black cherry (*P. serotina*) takes an excellent finish, and therefore is highly desirable for cabinet making and for interior finishing of houses. The wood of other species of the genus is used in the manufacture of pipes and furniture. Most of the plants of the order contain no injurious substances. *Malic acid* $C_4H_6O_5$ occurs in the fruit of the cherry (*Prunus Cerasus*), plum (*P. domestica*), the apple (*Pyrus Malus*), the strawberry (*Fragaria virginiana*), (*F. vesca*), etc. *Salicylic acid* $C_7H_6O_3$ occurs in the fruit of the strawberry, *citric acid* in *Rubus*, the strawberry and *Prunus domestica*. The *Quillaja Saponaria* contains *saponin*, the bark yielding 2 per cent. Kobert distinguishes two substances *quillajic acid* $C_{19}H_{30}O_{10}$ and *sapotoxin* $C_{17}H_{26}O_{10}$.

The glucoside *amygdalin* was first obtained in 1830 by Robiquet and Boutron from the seeds of the bitter almond. Liebig and Woehler named the substance which converts the *amygdalin* into the so-called essence of bitter almonds, *emulsin*. They found that through the action of *emulsin*, sugar and *prussic acid* were formed. The name *synaptase* was given to *emulsin*.

$$\begin{array}{ccccccccc} C_{20}H_{27}NO_{11} & + & 2H_2O & = & C_7H_6O & + & HCN & + & 2C_6H_{12}O_6. \\ \text{Amygdalin} & & & & \text{Benzoic} & & \text{Prussic} & & \text{Glucose} \\ & & & & \text{aldehyde} & & \text{acid} & & \end{array}$$

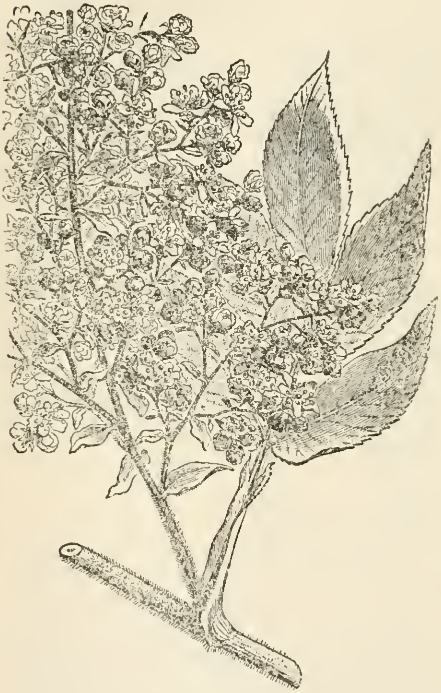
Emulsin can also convert *salicin, helicin, phlorizin*, and *arbutin*. The change in *arbutin* is as follows:

$$\begin{array}{ccccccc} C_{12}H_{16}O_7 & + & H_2O & = & C_6H_6O_2 & + & C_6H_{12}O_6. \\ \text{Arbutin} & & & & \text{Hydroquinon} & & \text{Glucose} \end{array}$$

In the cherry leaves *emulsin* occurs in the leaves and younger branches. *Emulsin* also occurs in *Penicillium glaucum* and *Aspergillus niger*.

The Kooso (*Brayera anthelmintica*) is a large dioecious ornamental tree from Abyssinia. The drug comes from the pistillate flowers which have a tea-like odor but a bitter, nauseous taste and contain *cuscotoxin* which is a muscle poison, *protocosin* and *cosin* which is bitter and acrid. In medicine it is used as a taeniafuge but in large doses produces vomiting and colic. *Agrimonia gryposepala, Gillenia stipulacea*, and *Geum urbanum* are used as astringents. The roots of the water avens (*Geum rivale*) are tonic and powerfully astringent. The soap-bark (*Quillaja Saponaria*) of Peru and Chili is used as an expectorant and is an irritant poison. According to Schneider who investigated a great many of the saponins which occur injuriously in about fifty families, they act poisonously by dissolving the blood corpuscles. *Cholesterin* contained in the body acts as a natural antidote against them.

Several plants of the order produce members of the terpene group; rose oil, contains *rhodinol* $C_{10}H_{18}O$, supposed to be identical with geranium oil; and a second terpene, *roseol,* $C_{10}H_{20}O_7$. Many fruits of the order, especially Pomeae, contain *mannite* and *sorbite.* The *arbutin,* $C_{12}H_{16}O_7$ obtained in many plants also occurs in some plants of this order; the glucoside *hydrochinon,* $C_7H_{12}O$, occurs in the buds of pears. *Quercetrin* $C_{15}H_{10}O_7$, derived from a glucoside, is found in the flowers of haw (*Crataegus*), the bark of apple trees and of *Prunus instititia. Amygdalin* $C_{20}H_{27}NO_{11}$, occurs in the seeds of many plants of the family, especially in *Pomeae* and *Pruneae*; also in the bark of *Prunus Padus, P. serotina,* etc., and in the seeds of *Pyrus Aucuparia.*



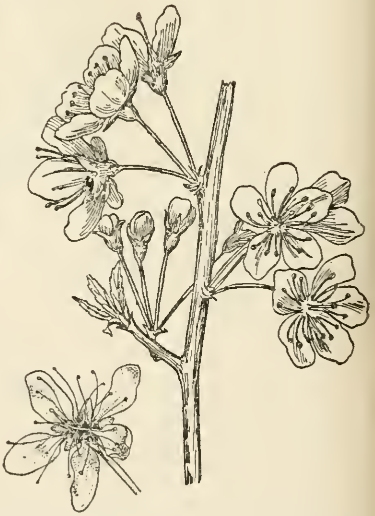


Fig. 266. Kooso (*Brayera anthelmintica*). Flowering branch. Contains a muscle poison. (After Faguet). Fig. 266a. Common Wild Plum (*Prunus americana*). (C. M. King).

Genera of *Rosaceae*

Ovary inferior or enclosed in the calyx tube.
    Carpels numerous; fruit an achene..................................3. Rosa.
    Carpels few, fruit not an achene.
        Carpels cartilaginous; fruit a pome..........................4. Pyrus.
        Carpels bony, drupe-like....................................6. Crataegus.
Ovary superior not enclosed in calyx tube.
    Calyx deciduous; fruit a drupe....................................5. Prunus.

Calyx persistent.
  Pistils numerous; fruit drupelets............................1. Rubus.
  Pistils numerous; fruit an achene........................2. Fragaria.

1. *Rubus.* Raspberries and Blackberries

Perennial herbs, shrubs or vines; vine prickly, with alternate leaves, 3-7 foliolate or simple; flowers terminal; axillary or solitary, white reddish or pink, usually perfect; calyx 5-parted, petals 5, deciduous; stamens numerous; achenes usually many, inserted on the receptacle, which is either fleshy or dry; carpels forming drupelets. About 200 species chiefly Northern.

Rubus Idaeus L. var. *aculeatissimus* (C. A. Mey.) Regel & Tiling. Wild Red Raspberry

Stems biennial, upright shrubs covered with straight, stiff bristles, some hooked, and glandular hairs; leaflets 3-5, oblong, ovate, pointed, whitish, downy underneath; petals as long as the sepals, whitish; fruit light red. Spreads by suckers.

Distribution. The species is native to the Appalachian Mountains as far south as the Carolinas; common at high altitudes in the Rockies. Frequently

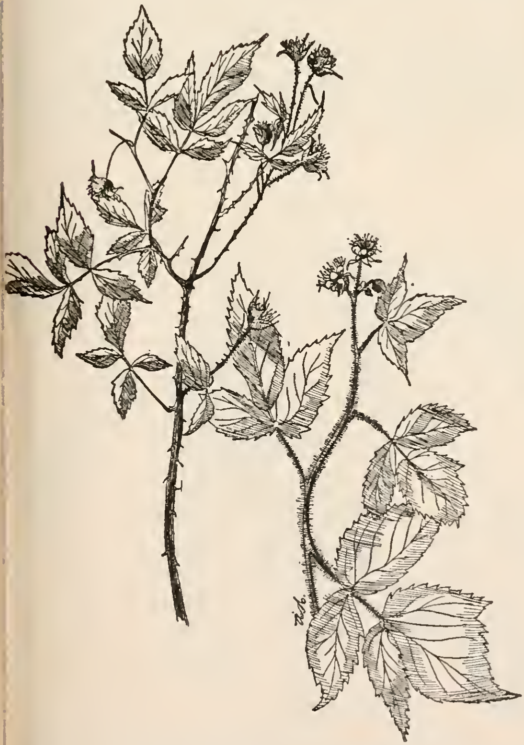


Fig 267. Wild Red Raspberry (*Rubus Idaeus, var-uleatissimus*). The prickles of the red raspberry produce chanical injury. (Ada Hayden).

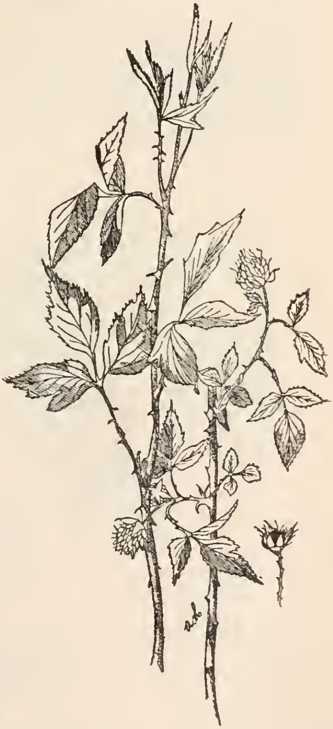


Fig. 268. Wild black cap raspberry (*Rubus occidentalis*). This plant has thorns which are irritating. (Ada Hayden).

troublesome in fields for several years in the north and persists for a long time in gardens. A common native of the north.

Rubus occidentalis L. Black Raspberry, or Black-cap Raspberry

Stems biennial, glaucus, recurved, beset with hooked prickles; rooting at the tip; leaves pinnately 3-foliolate, or rarely 5-foliolate; leaflets ovate, coarsely doubly serrate, whitish underneath; flowers corymbose clusters; petals shorter than the sepals; fruit usually purplish-black, occasionally white.

Distribution. Quebec to Georgia, to Missouri, to Minn. Like the preceding species, often troublesome in fields and gardens.

Rubus villosus Ait. High Bush Blackberry

Shrubs 1-6 feet high, upright or reclining, armed with stout recurved prickles, branchlets and lower surface of leaves glandular; leaflets 3-5, ovate, pointed, terminal one stalked; flowers in corymbose clusters; petals white; fruit not separating from the juicy receptacle, blackish.

Distribution. From Nova Scotia to Georgia, Missouri, Kansas, to Minn. Troublesome like the black-cap Raspberry.

Injurious properties. No species of the genus Rubus is known to be poisonous, but the bristles and spines on various species frequently inflict injuries Numerous cases of inflammation, and later pus formation, are reported from the prickles found on the common red raspberry. This is especially true of the larger prickle of the black raspberry and the dewberry. The bark of the blackberry contains *villosin.* The leaves are said to cause an irritation of the skin of berry pickers or others who walk among the bushes.

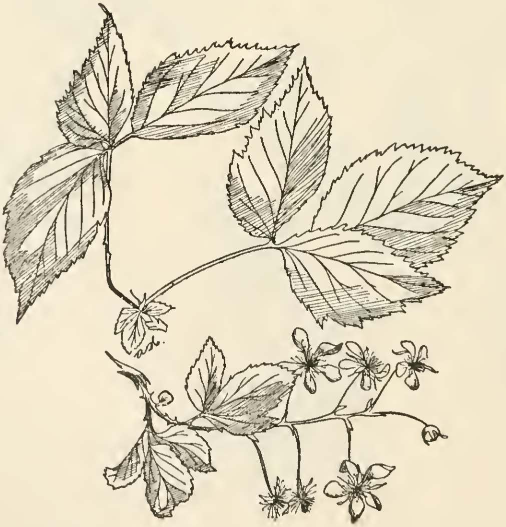


Fig. 269. Common Blackberry (*Rubus villosus*). The common blackberry produces prickles which act injuriously in a mechanical way. (Ada Hayden).

2. *Fragaria* L. Strawberry

Perennial stemless herbs; leaves petioled, stipulate, 3-foliolate; flowers white, in clusters, polygamo-dioecious; calyx persistent, with 5 bractlets, deeply 5-lobed; petals 5; stamens numerous; carpels or pistils numerous; the receptacle elongated, which become fleshy in fruit. A small genus of about 25 species containing the common cultivated strawberry (*F. chiloensis*) of the Pacific coast, our wild strawberry (*F. virginiana*), the European strawberry (*F. vesca*) and the Indian strawberry (*F. Indica* or *Duchesnea indica*).

Fragaria vesca L. European Wood Strawberry

A perennial with ovate leaves, dentate, thin; flowers white, racemose receptacle, elongate, fruit with achenes, seeds free above the receptacle. It is very different from our common wild strawberry, in which the achenes are sunken in the flesh.

Poisonous properties. Few people would suspect that the seeds of the strawberry are injurious, but I have known people who have found that the eating of the common cultivated strawberry is injurious, and it is known that the European strawberry (*F. vesca*) produces a rash that sometimes resembles that produced by scarlatina. Dr. Millspaugh, in speaking of the European strawberry, says of a lady coming under his care who had consumed the fruit of the strawberry grown in Florida:

> In the afternoon of the same day the skin was hot and swollen, the patient thirsty and restless, and little sleep was gained that night; the next day the eruption began to fade, the appetite returned, and restlessness ceased. On the third day exfoliation began and was very profuse, the skin appearing quite similar to the condition existing after a severe attack of scarlatina.

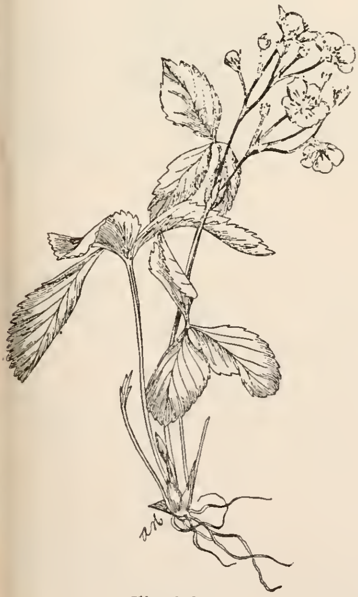


Fig. 270

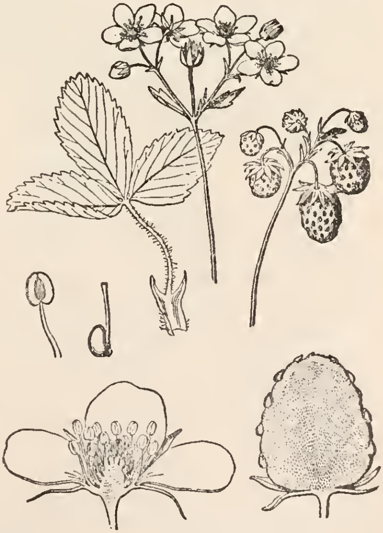


Fig. 270a

Fig. 270. Wild Strawberry (*Fragaria virginiana*). (Ada Hayden). Fig. 270a. Wild Strawberry (*Fragaria vesca*). (Willis).

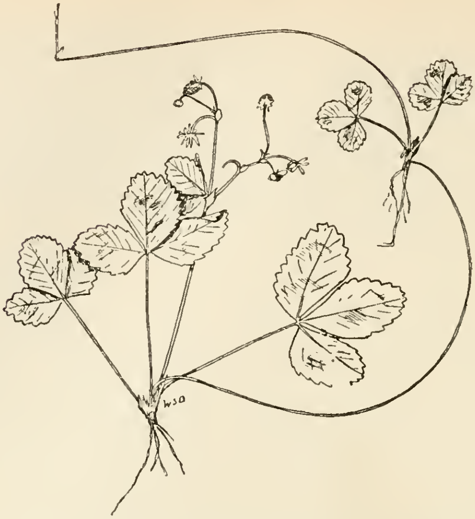


Fig. 271. European Wood Strawberry (*Fragaria vesca*). This plant occurs in fields and along roadsides. Sometimes causes dermatitis. (W. S. Dudgeon).

Prof. Prentiss * reports the case of a man who, at the age of 14, had become quite ill from eating strawberries and forever afterward could not eat them without becoming ill.

3. *Rosa* L.

Erect or climbing shrubs, with prickly stems, alternate leaves adnate to the petioles; flowers showy, corymbose, or solitary; calyx urn-shaped; stamens and carpels numerous; achenes, enclosed in a berry-like calyx tube. Several species of the genus *Rosa* are more or less troublesome in fields. The *Rosa centifolia,* used for preparing rose water contains a volatile oil. A confection is made from the hips of *Rosa canina. R. gallica* contains a volatile oil and a yellow crystalline glucoside *quercitin.*

Rosa pratincola Greene. Prairie Rose

An erect perennial shrub with densely prickly stems bearing slender bristles; narrow stipules, more or less glandular, toothed; leaflets 7-11, broadly elliptical to oblong-lanceolate, sessile or nearly so; flowers corymbose or rarely solitary, pink; sepals lanceolate, somewhat glabrous; fruit smooth.

Distribution. Common on prairies of Wisconsin, Iowa to Texas, New Mexico and Montana. In Iowa, Missouri and parts of Minnesota and Arkansas, it is most troublesome.

Rosa blanda Ait. Smooth Rose

An erect shrub with few straight prickles or wholly unarmed; from 1-3 feet high; leaflets 5-7, short stalked; oblong-lanceolate; cuneate; stipules dilated, naked or slightly glandular-toothed; flowers usually large, corymbose or solitary.

Distribution. From Newfoundland to Ontario and Illinois.

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* Bot. Gazette 13:19.

Rosa Sayi. Schw. Say's Rose

A very prickly shrub with low stem, 1-2 feet high; leaflets 3-7 broadly elliptical or oblong, lanceolate, glandular, ciliate and resinous; stipules dilated; flowers large, solitary or rarely more; outer sepals usually with 1 or 2 narrow lateral lobes.

Distribution. From northern Michigan, Northwest Territory to Colorado.

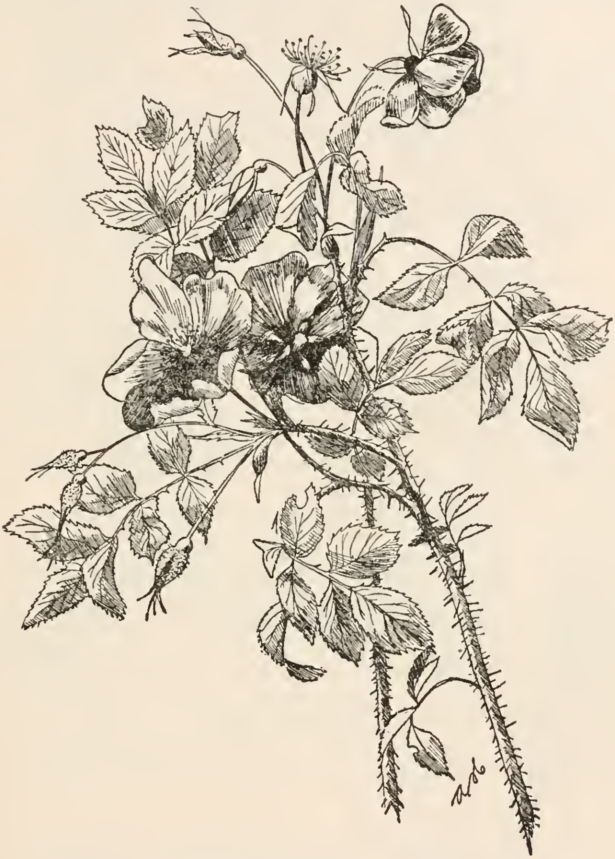

Fig. 272. Arkansas Rose (*Rosa pratincola*). A native rose. (Ada Hayden).

Rosa Woodsii Lindl. Wood's Rose

Stems usually low; 6 inches to 3 feet high with slender, straight or recurved spines and scattered prickles, or unarmed above; leaflets 5-7 obovate to oblong or lanceolate, more or less toothed; flowers corymbose or solitary; sepals naked or hispid; fruit globose.

Distribution. Prairies of Minnesota and from Montana to New Mexico and Texas.

Mechanical injuries. The prickles inflict injury to cattle, and are especially troublesome in grain fields. Before the binder came into use men were injured by the prickles and spines of the rose which produced inflammation and caused the formation of pus.

4. *Pyrus* L.

Trees or shrubs; simple leaves; flowers in cymose clusters, white or pink; calyx urn-shaped, 5-lobed; petals 5, short-clawed; stamens usually numerous; styles mostly 5, distinct or united at the base; ovules 2 in each cavity; carpels leathery; fruit a pome. About 37 species of wide distribution, chiefly in the North Temperate region. The following species of the genus are cultivated for their fruits; quince (*P. Cydonia*), pear (*P. communis*), Japan or sand pear (*P. sinensis*), apple (*P. Malus*), Old World crab apple (*P. baccata*), mountain ash (*P. americana*), (*P. sitchénsis P. sambucifolia*), European mountain ash (*P. Aucuparia*).

The fresh bark of the wild mountain ash is used in medicine; it is known to produce irritation of the alimentary mucous membranes, and a reflex nervous irritation.

Pyrus coronaria L. Wild Crab Apple

A small tree with petioled or ovate to triangular-ovate leaves, sparingly pubescent beneath; sharply serrate and often lobed; flowers rose-colored, fragrant; calyx slightly pubescent; pome fleshy, fragrant, greenish-yellow, acid. Two other species are found in eastern North America, namely, *P. angustifolia,* with small leaves and few flowers, and *P. ioensis,* with firm leaves, narrowed at the base, and pubescent calyx, chiefly west in the Mississippi Valley, *P. rivularis* Dougl., occurs from California to Alaska.

Distribution. Our Eastern wild crab is found from Ontario to Michigan and South Carolina; in the west it is replaced by the *P. ioensis.*

Poisonous and medicinal properties. All the species of the genus *Pyrus* contain the glucoside *amygdalin,* $C_{20}H_{27}NO_{11}$, which is converted by the action of the ferment into *hydrocyanic acid.* The bark also contains *citric acid,* $C_6H_8O_7$, and *malic acid,* $C_4H_6O_5$, both of which appear in the fruit of the apples. There may be occasionally cases of poisoning where animals are allowed to browse upon the wilting leaves of the apple.

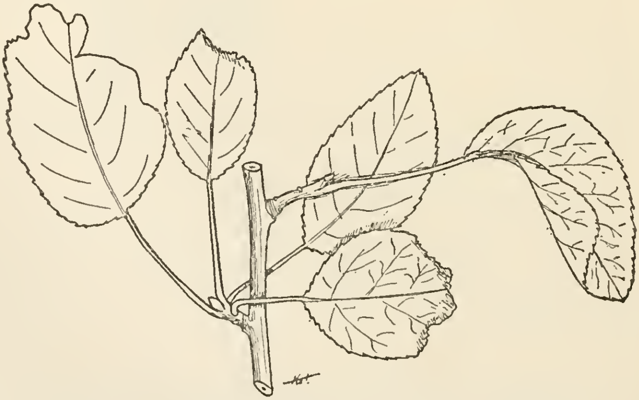

Fig. 273. Common apple (*Pyrus Malus*). The well known cultivated apple. (W. S. Dudgeon).

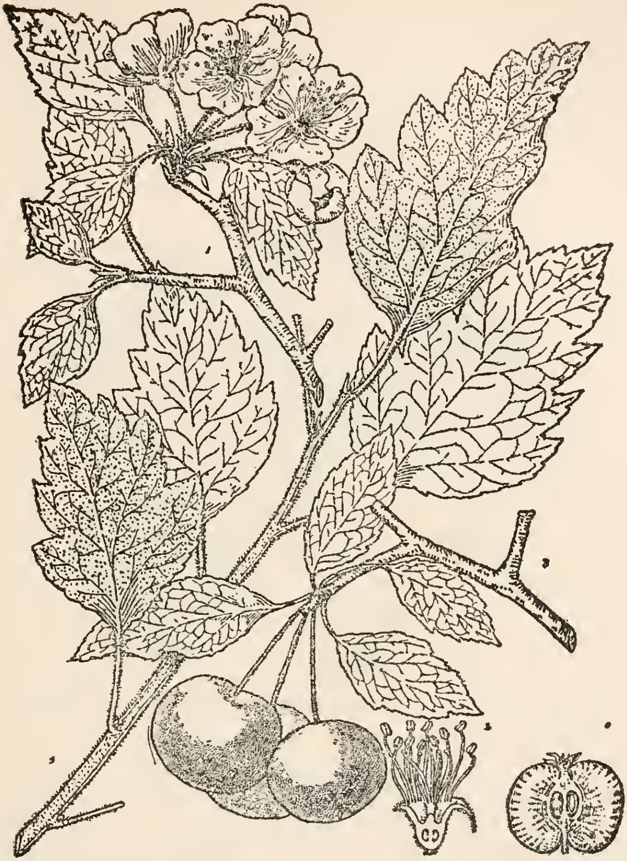

Fig. 274. Iowa Crab (*Pyrus ioensis*). 1. Flowering branch. 2. Longitudinal section of flower with petals removed, natural size. 3. Fruiting branch. 4. Longitudinal section of fruit. 5. Summer branch. 1, 3, 4, 5, one-half natural size. (M. M. Cheney).

Crataegus L. Hawthorn. White Thorn

Shrubs or small trees, usually spiny; leaves petioled; flowers in corymbose clusters, white or pink; calyx-tube urn-shaped; limb 5-cleft; petals 5, roundish; stamens numerous or few; styles 1-5; fruit a pome, containing 1-5 bony, 1-seeded stones. About 75 species, although the number is sometimes estimated as high as 125. Some species, like *C. punctata*, and *C. mollis*, are ornamental.

Crataegus mollis Scheele

Shrub or small tree; shoots densely pubescent; leaves large, slender-petioled, cuneate, truncate or cordate at base, usually with acute lobes; more or less densely pubescent beneath; flowers large, 1 inch across; fruit bright scarlet with a light bloom.

Distribution. Common in thickets from Eastern Canada to Iowa and Kansas, and Texas.

Poisonous properties. Large numbers of haw fruits are eaten, and several deaths due to the eating of Crataegus have been reported in Iowa. These were probably largely due to strangulation or indigestibility of the stony "seed." The flesh is said to be indigestible as well.

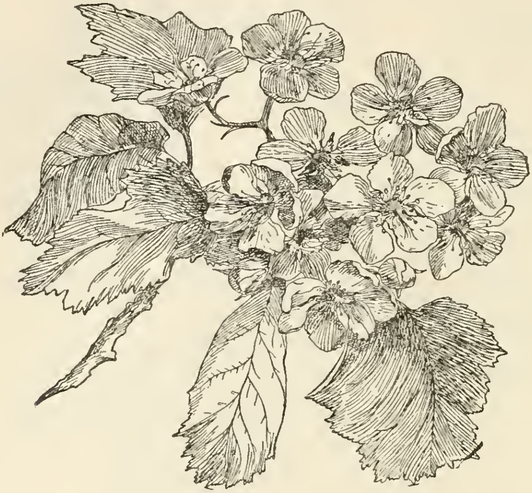

Fig. 275. Common Red Haw (*Crataegus mollis*). (C. M. King)

5. *Prunus* L. Plum and Cherry.

Shrubs or trees with alternate petioled leaves and small stipules; flowers variously clustered, mostly perfect; calyx inferior, free from the ovary, with a bell-shaped or urn-shaped tube and 5 spreading lobes; falling after flowering; petals white or pink; spreading stamens 15-20 or more, distinct, inserted on the throat of the calyx, perigynous; pistil solitary; style simple; stigma capitate; ovary 1-celled, 2-ovuled; fruit a drupe; seed usually one; embryo large, cotyledons fleshy, endosperm absent. Species about 90, of the north temperate regions, tropical America and Asia. The sweet cherry (*Prunus avium*), sour cherry (*P. Cerasus*), native plum (*P. americana*), Chicksaw plum (*P. Chicasa*), European plum (*P. domestica*), Japan plum (*P. triflora*), the flowering almond (*P. triloba*), peach (*P. persica*), and apricot (*P. armeniaca*) are all well known in cultivation.

Prunus virginiana L. Choke Cherry

A tall shrub or small tree, bark gray; leaves thin, oval, oblong or obovate, acuminate at the apex, smooth or slightly pubescent, sharply serrate, teeth large; often doubly serrate; flowers white in rather loose racemes, terminating leafy branches; petals roundish, fruit red, turning dark or crimson. Astringent.

Distribution. Forming thickets from New Foundland to Manitoba to Texas and Georgia.

Wild Cherry (*Prunus demissa*). Common shrub of the Rocky Mountains. (Photo by Colburn).

Prunus demissa Walp. Western Wild Cherry or Choke Cherry

A shrub or small tree; leaves thick and oval or obovate, acute or more or less obtuse at the apex; teeth rather short; flowers white in dense racemes, terminating leafy branches; fruit dark or purplish black, less astringent than the preceding.

Distribution. Dry soil, common in thickets and woods from Dakota to Kansas, New Mexico to California and British Columbia.

Prunus serotina Ehrh. Wild Black Cherry

Large tree with reddish brown branches, reddish wood; leaves thick, oblong, or lanceolate-oblong, taper pointed, serrate, with short teeth shining above; flowers in elongated spreading or drooping racemes; petals obovate; fruit purplish black, and slightly astringent.

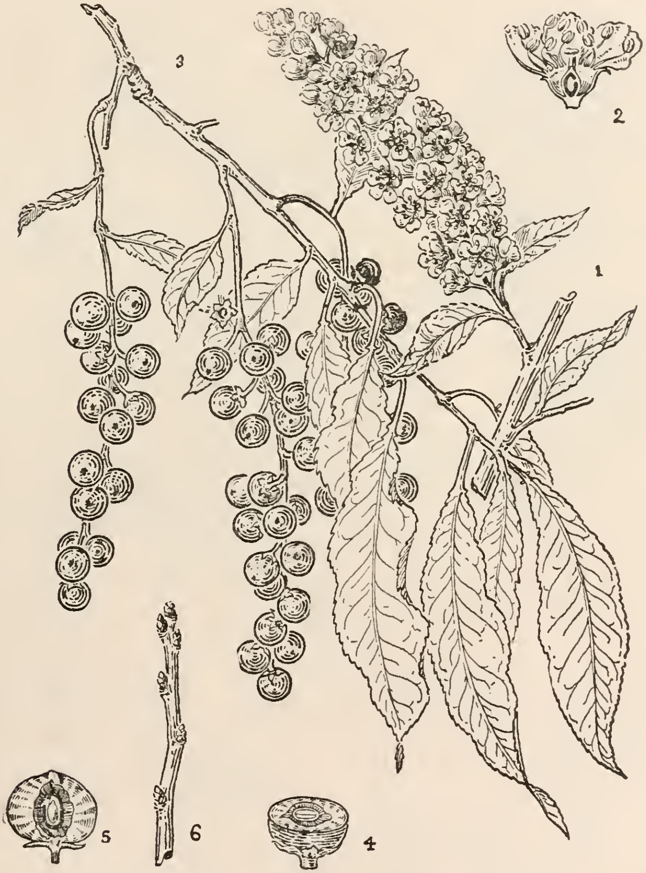

Fig. 276. Black cherry (*Prunus serotina*). 1. Flowering branch. 2. Longitudinal section of flower, enlarged. 3. Fruiting branch. 4. Cross section of fruit. 5. Longitudinal section of fruit. 6. Winter branchlet. 1, 3, 6, one-half natural size. 4, 5, natural size. (M. M. Cheney in Green's Forestry in Minnesota.)

Distribution. From New England to Ontario, to Florida and Texas, Kansas, Dakota and Minnesota.

Prunus pennsylvanica L. Wild Red Cherry

A small tree 20-30 feet high, light brown bark; leaves oval or lanceolate, acute or acuminate, finely and sharply serrate, glabrous, with slender petiole; flowers white in corymbose clusters; fruit small, globose, light red hue and sour.

Distribution. In rocky woods. New Foundland to the Rocky Mountains to Georgia.

Poisonous properties. Many cases of poisoning have been recorded from eating the seeds of peach and bitter almonds. They contain a highly poisonous

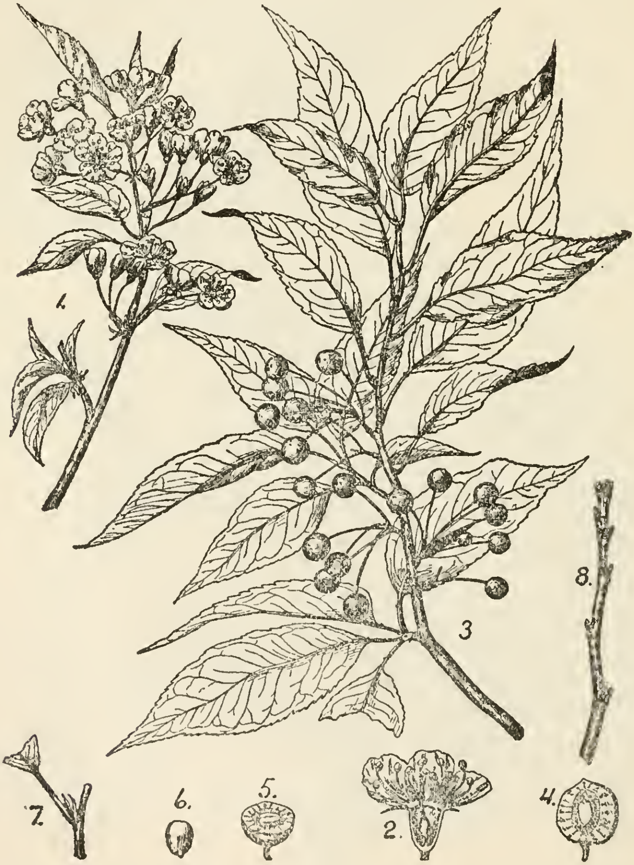

Fig. 277. Wild Red Cherry (*Prunus pennsylvanica*). 1. Flowering branch. 2. Longitudinal section of flower. 3. Fruiting branch. 4. Longitudinal section of fruit, slightly enlarged. 5. Cross section of fruit. 6. Embryo enlarged. 7. Axil of leaf, showing stipules. 8. Winter branchlet. 1, 3, 7, 8, one-half natural size. (M. M. Cheney.)

substance from which prussic acid is obtained. Mr. Chesnut says in regard to the black cherry:

> The fruit is rather agreeable, being but slightly bitter and astringent in taste. In some localities it is much used to flavor liquor. Poisoning is frequently caused by cattle eating the wilted leaves from branches thrown carelessly within their reach or ignorantly offered as food. Children occasionally die from eating the kernels of the seed or from swallowing the fruit whole.

Prof. Chas. D. Howard, of the New Hampshire Station, says:

> The poisonous property of all species of cherry leaves is due to hydrocyanic acid, popularly known as prussic acid. This compound does not exist as such in the growing leaf, but is derived from a class of substances called glucosides, of which *amygdalin* is the type peculiar to the cherry. This, or a closely allied body, is to be found not only in the leaves and bark, but especially in the stones of cherries, peaches and plums, and the seeds of the apple. By the action of moisture and a vegetable ferment called *emulsin,* which exists in the plant, a complex chemical reaction takes place, that begins in the leaf the moment connection with the circulatory system is cut off. The three products of this reaction are *hydrocyanic acid,* grape sugar and *benzaldehyde,* or bitter almond oil.
>
> There is a popular opinion that the leaves of the cherry are poisonous only when cut and in the wilted condition; that cattle may safely nibble them from the growing shrub without danger of injury; and that they are quite harmless when dried. Our observations, however, prove these views to be but partially correct. As a matter of fact, distillations of samples, made within twenty minutes of cutting, show that the freshly cut leaves yield nearly as much acid as the wilted ones do when calculated on the weight of fresh material taken, and when eaten fresh, the character of the juices within the animal stomach is such as to render that organ a most favorable place for the conduct of the reaction in which prussic acid is liberated.
>
> On the other hand, while it is true that the thoroughly dried leaves yield a comparatively small amount of acid, still they may always produce some, and as ordinarily dried in the hayfield, they may be capable of generating a considerable quantity of the poison. The desirability of carefully excluding them from all hay is therefore apparent.
>
> One hundred grams of bitter almonds (*Prunus amygdalus communis*), in the form of pulp, yield 250 milligrams prussic acid; the same amount of kernels from cherry stones yields 170 mgs.; leaves of the cherry laurel (*Prunus Laurocerasus*), occurring in Europe and Mexico, 39 mgs.; kernels of peach, 164 mgs.; apple seeds, 35 mgs. The stones of all these species must therefore be regarded as dangerous; the fruit, in every case, so far as can be ascertained, is harmless.
>
> The leaves of the wild black cherry are the most poisonous of the three species investigated, though all are dangerous.
>
> Both the wilted leaves and fresh leaves are poisonous, while the dried are to be regarded with suspicion.
>
> Vigorous, succulent leaves from young shoots, which are the ones most liable to be eaten by cattle, are far more poisonous than the leaves from a mature tree or stunted shrub.
>
> Leaves wilted in bright sunlight to about 75 per cent original weight, or until they begin to appear slightly limp and to lose their gloss, yield the maximum amount of prussic acid.

I have seen cattle browse on the leaves of *Prunus demissa* in the Rocky Mountains. It is believed by stockmen to be poisonous. Probably the danger is not so great because the leaves are eaten direct from the tree and not wilted. The Bureau of Forestry has shown that much loss occurs which can easily be prevented by changing the trail.

It has been known for a long time that seeds of the various members of the genus Prunus contain poisonous properties. The bark of several of our wild cherries is also known to contain a poisonous principle, a ferment known as *emulsin,* which in the presence of water acts on the glucoside *amygdalin* $C_{20}H_{27}NO_{11}$, and produces *hydrocyanic acid,* a powerful poison; it is a clear, colorless liquid of a characteristic taste and odor, resembling that of a bitter almond. Externally, *hydrocyanic acid* produces a paralytic effect. When taken internally, it acts as a sedative upon the mucous membrane. Prof. Winslow gives the following characteristics of poisoning:

> In poisoning, the blood becomes first a bright arterial hue, and later assumes a dark, venous color. The first condition is due to the fact that the blood does not give up its oxygen for some reason. Brunton suggests that it is because the blood is hurried so rapidly through the dilated peripheral vessels that it does not have time to yield up its oxygen. The dark color of the blood is probably owing to asphyxia and accumulation of carbonic dioxide, following the paralytic action of prussic acid upon the respiratory centre.
>
> Prussic acid has an essentially depressing action upon the nervous system as a whole. The brain, cord and nerves become paralyzed by large doses.
>
> The spinal cord is paralyzed at a period after coma and convulsions have appeared. The peripheral nerves and muscles are paralyzed directly by toxic doses, and not through the mediation of the central nervous apparatus.
>
> Inhalation of the pure acid will cause death in a confined atmosphere, and even inhalation of the medicinal solution will induce the physiological symptoms of the drug.

He also says of the toxicology of prussic acid:

> Prussic acid is one of the most powerful poisons in existence. Death may be instantaneous, or life may be prolonged for over an hour after lethal dose. More commonly the animal survives for a few minutes, and we observe the following symptoms in dogs: The animal falls, froths at the mouth, the respiration is of a gasping character and occurs at infrequent intervals. There is unconsciousness, the pupils become dilated, there are muscular tremblings, and clonic or tonic spasms. Defecation and micturition occur, and erections often ensue in the male. Respiration ceases before the cardiac pulsations.
>
> Three stages may be distinguished in fatal poisoning. First: a very short period elapses before the symptoms appear. There are giddiness, difficult breathing, and slow pulse in this stage. Second: the pupils dilate, vomiting may occur, and the animal utters loud cries. Spasmodic defecation, micturition and erections may be present, with convulsions and unconsciousness. Third: the last stage is characterized by collapse, spasms, general paralysis and death. The subacute form of poisoning may ensue and prove fatal, or, owing to the volatile character of the drug, complete recovery may take place within one-half or three-quarters of an hour. Occasionally dogs continue to be paralyzed for several days and get well. The minimum fatal dose recorded in man is 9/10 of a grain of pure acid, or about 50 drops of the medicinal solution. Four to five drachms of the diluted acid frequently, but not invariably, cause subacute poisoning and death, in horses, within an hour. One to two drachms of the pharmacopoeial preparation usually kill dogs within ten minutes.
>
> Prussic acid is commonly used to destroy the domestic animals. Two to four drachms of the medicinal acid are to be given to dogs and cats of the ordinary size, and certain, painless, and rapid death will occur if a fresh preparation of the drug can be obtained. The unopened, half-ounce vial, kept by druggists, is recommended. Big dogs, horses, and the other larger animals are not killed rapidly, nor sometimes at all, by great quantities of the diluted acid. Hence, shooting is a more humane and preferable mode of death for them. In the experience of the writer, one to two drachms of prussic acid saturated with potassium cyanide, failed to kill a horse, when injected directly into the jugular vein. The odor of the acid lingers about the animal for a few hours after death; the eyes are fixed and staring; the pupils dilated; the teeth are clinched tight and covered with froth, while the blood is of a very dark color. The treatment embraces emptying the stomach by large doses of promptly acting emetics, or by the stomach tube, or pump; atropin, ether, and brandy subcutaneously, and inhalations of ammonia, together with artificial respiration, and hot and cold douches upon the chest.

Hydrocyanic acid is produced by a number of other plants referred to in another connection.

Wild cherry bark (*Prunus serotina*) and leaves by distillation yield a volatile oil resembling that of bitter almond. The same is true of the *P. virginiana*. Hydrocyanic acid is formed only by the action of a ferment upon *amygdalin* which is present in all plants of this sub-order. Fresh leaves are generally considered harmless, but Chesnut says that cattle are frequently poisoned from eating the wilted leaves. He also adds that the seeds of all varieties of cherries and plums, both native and introduced are subject to suspicion. The flesh of none of the species is in any way poisonous. Chesnut also says in another contribution, that no cases are on record where stock have been poisoned by eating the leaves of any species, while still on the tree. It is only after they have been cut off and are partially wilted that they are considered dangerous. The reason for this is that during the process of wilting, prussic acid is formed from non-poisonous constituents which are always present in the leaf and bark. The wilted leaves have the characteristic odor of prussic acid. The amount of *amygdalin* contained varies from 3.6 to 4.12 per cent and yields from 0.23-0.32 *hydrocyanic acid.* Recent studies indicate that an amydonitril glucoside occurs in young leaves of both *Prunus Padus* and *P. serotina.*

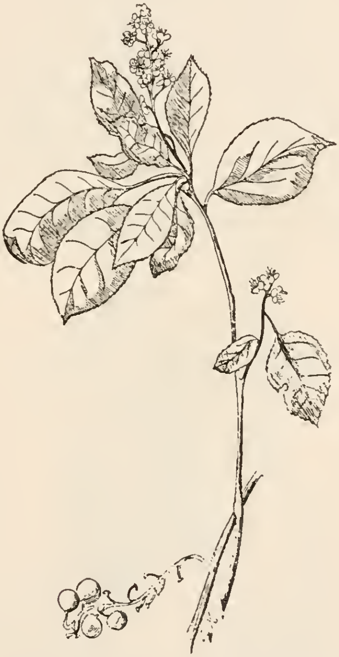

Fig. 278. The European May Day tree (*Prunus Padus*), poisonous. This is frequently cultivated. (Ada Hayden.)

LEGUMINOSAE

Herbs, shrubs, trees, or vines with alternate, mostly compound, stipulate leaves, papilionaceous or sometimes regular flowers; calyx 3-6, or 4-5 cleft; stamens 10, rarely 5 and sometimes many, monadelphous, diadelphous or distinct; pistil, simple, free, becoming a legume in fruit or sometimes a loment; ovules 1-many; seeds generally ex-albuminous or nearly so or, in some, with copious albumen. About 6500 species of wide distribution, but most abundant in the tropics.

Economic plants

The order contains a large number of economic plants, especially food plants. The common bean, (*Phaseolus vulgaris*), was originally found in the southwestern United States, but is now cultivated in all civilized countries. Common string and golden wax beans are types of the last named. The scarlet runner, (*P. multiflorus*), generally cultivated for ornamental purposes is also used as food, although the ripe beans are unwholesome and sometimes poisonous. The three-lobed kidney bean, (*P. trilobus*), is commonly cultivated in India. The lima bean, (*P. lunatus*), also native to America, supposedly Brazil, is not known in a wild state. The seed of the Adzuki bean, (*P. Mungo*, var. *glaber*), is used as food in Japan. The soy bean, (*Glycine Soja* and *G. hispida*), of which there are many varieties, is native to China and Japan and is used in large quantities by the Japanese and Chinese for food, but is little used in the United States, being here cultivated as a forage plant.

Soy beans can only be fed in moderate amounts to cattle because of their purgative properties. A loss of a considerable number of cattle occured in England recently where soy bean cake had been used. When fed mixed no trouble was caused, but when fed alone it caused poisoning.

The cow-pea, (*Vigna Catjang*), native to China, has been cultivated for centuries by the Chinese and extensively used for food. It is also used in many other warm countries, especially the southern states, not only for human food, but also as one of the best forage plants, for which purpose it is now

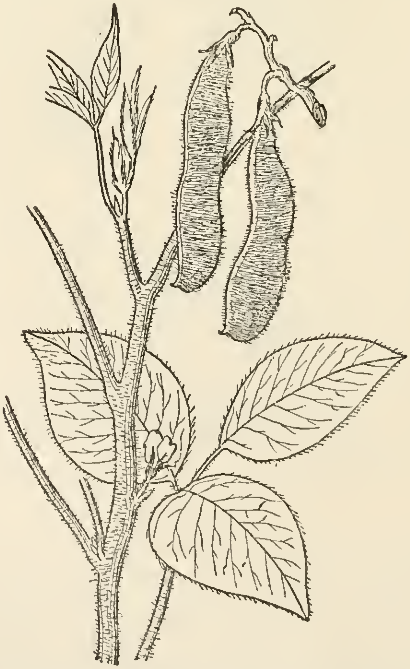

Fig. 279. Soja Bean (*Glycine hispida*), used both as a food and as a forage plant. (U. S. Dept. Agr.)

cultivated as far north as Minnesota; it is also a soil renovator. The *Dolichos Lablab* is used for food in the tropics. The yam bean, (*Pachyrrhizus angulatus*), in some countries, forms a resource as food in case of the failure of the usual crops. The garden pea, (*Pisum sativum*), probably originated in western Asia along the foothills of the Caucasus. It has, however, long been cultivated in Europe. Some authorities believe that it may have originated from the field pea (*Pisum arvense*). The pea is extensively cultivated in Europe and Canada as a forage plant. The chick pea, (*Cicer arietinum*), is a native to Caucasus and the Caspian Sea region and has been cultivated since remote times in northern Africa and other Mediteranean countries. In the United States, it is cultivated chiefly in the arid regions both for stock and for human food. The lentil (*Lens esculenta*) has been cultivated in the Mediterranean region for centuries but its original home is not known. It is grown and used now from Central Europe south and east to India, as food for both men and stock. The peanut (*Arachis hypogaea*), probably native to Brazil, was cultivated by the ancient Peruvians but is now widely scattered in all warm countries. The nut (seed) is used as food and a fine oil is extracted from it. A plant allied to the peanut (*Voandesia subterranea*) is used as an article of food in western and southern Africa. The pigeon pea (*Cajanus indicus*) is an important article of food in the tropics, especially in India, and is also used as a fodder plant. The sword bean (*Canavalia ensiforme*) and the Jackpea (*C. obtusifolia*), cultivated in the tropics are used as food, the skin having been

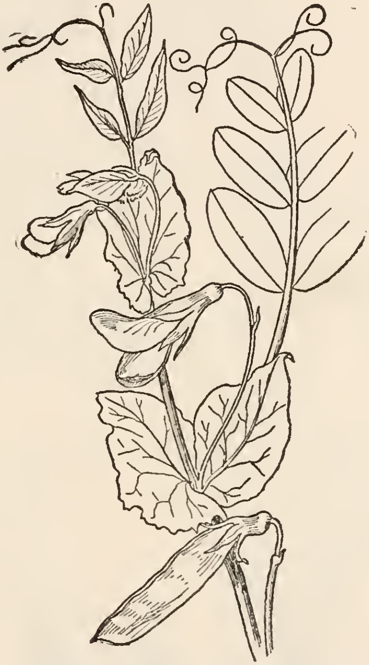

Fig. 280. Garden pea (*Pisum sativum*), a valuable food plant. (U. S. Dept. Agr.)

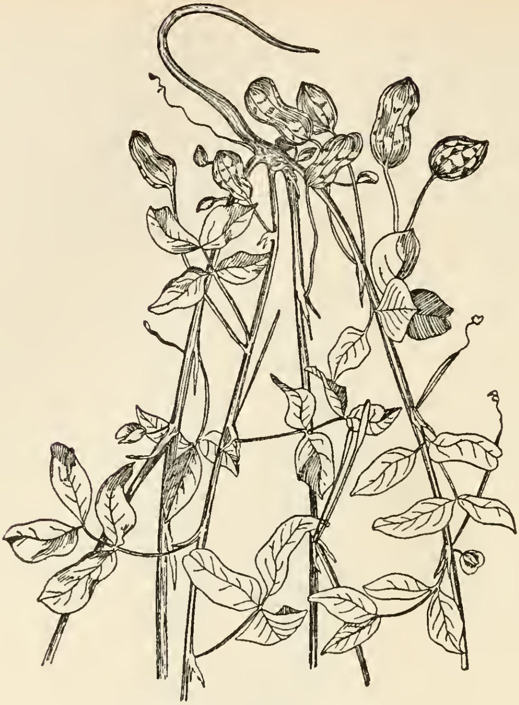

Fig. 281. Peanut (*Arachis hypogaea*).

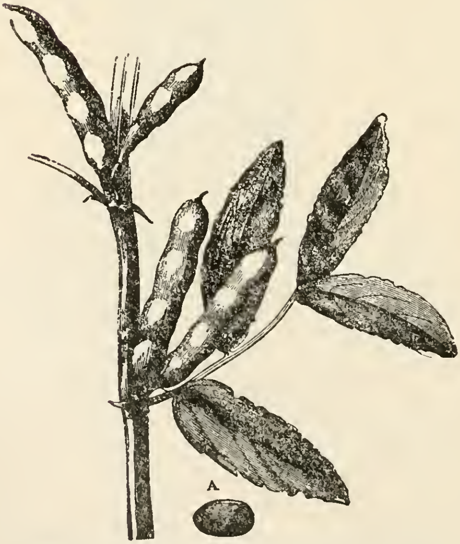

Fig. 282. Broad Bean (*Vicia Faba*). Cultivated both as a food and as a forage plant. (From the American Agriculturist.)

first removed. The broad bean (*Vicia Faba*) is much cultivated in Europe for both animal and human food. The seeds of *Paprika africana* are used as food by native Africans and in Abyssinia and in the Indian Archipelago are esteemed as a good substitute for coffee.

The Australian wattles (*Acacia*), of which there are many species, vary greatly in size. The bark of some of these is used for tanning purposes. The wood is valuable and takes a fine polish, *A. Gerrardi* being an example of this class. From *A. Farnesiana* is derived the oil of cassia, much used in perfumery. It is prepared by macerating the flowers in olive oil. Cassia pomade is prepared from fatty substances to which the cassia flowers have been made to impart their perfume. *C. occidentalis* is used as a substitute for coffee. Many of the legumes produce important gums. From the Algarrobe, or locust tree of Jamaica (*Hymenaea Courbaril*) is produced a gum said to be superior to shellac; the sweet pulp of the fruit is edible. The gum Kino (*Pterocarpus Marsupium*) is a native of India and yields a gum that is used both for tanning and dying and as an astringent. Kino contains from 40-80 percent of tannin and kino red. *P. tinctorius* produces a valuable wood, and a related species (*P. Dalbergioides*) produces a wood similar to mahogany. The Tonka bean or Tonquin (*Dipteryx odorata*) of Guinea contains the substance *cumarin* and is used as a snuff and as a scent in cigars. *Cumarin* is widely distributed in the plant kingdom, especially in such *Leguminosae* as *Dipteryx, Melilotus,* and *Myroxylon.* It occurs in species of other families, as the palm, vernal

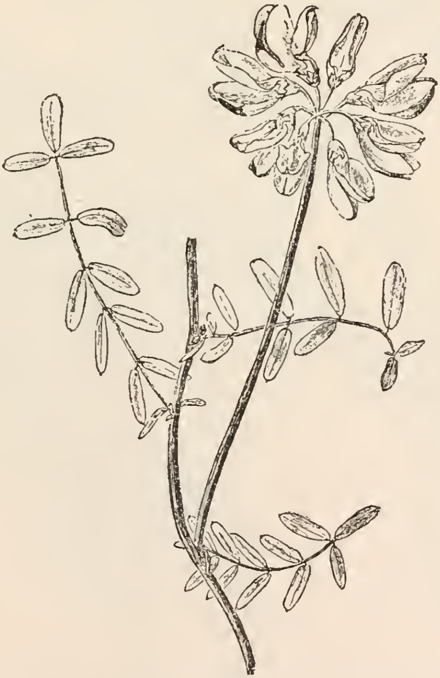

Fig. 283. Axwort (*Coronilla varia*). A poisonous plant of Europe—adventitious in the U. S. (From Strasburger, Noll, Schenck and Schimper.)

grass, madder, rue, and orchids, in such composites as *Trilisa,* in the rootstock of *Vitis sessilifolia* and in *Prunus Mahaleb.* It is most easily detected when the plant begins to wilt or after it is dead. *Pseudocumarin* $C_7H_4O_2$, is like the odorous substance found in *Coronilla scorpioides.* The seeds of *Mucuna giganteum* and of *M. pruriens* are used for various purposes as watch charms, or as other ornaments.

Some species of the family which contain a good fiber are applied in weaving cloth. A species of *Crotalaria, C. juncea* is cultivated in India for its tough fiber, and is used for making ropes and bags. *Sesbania aculeata,* a branched annual, is also cultivated for its fiber. The stems of Shola (*Aeschynomene aspera*) native to India are used for making hats. Blue indigo dyes come from *Indigofera Anil* of the West Indies. The *Genista tinctoria* or Dyers' Broom

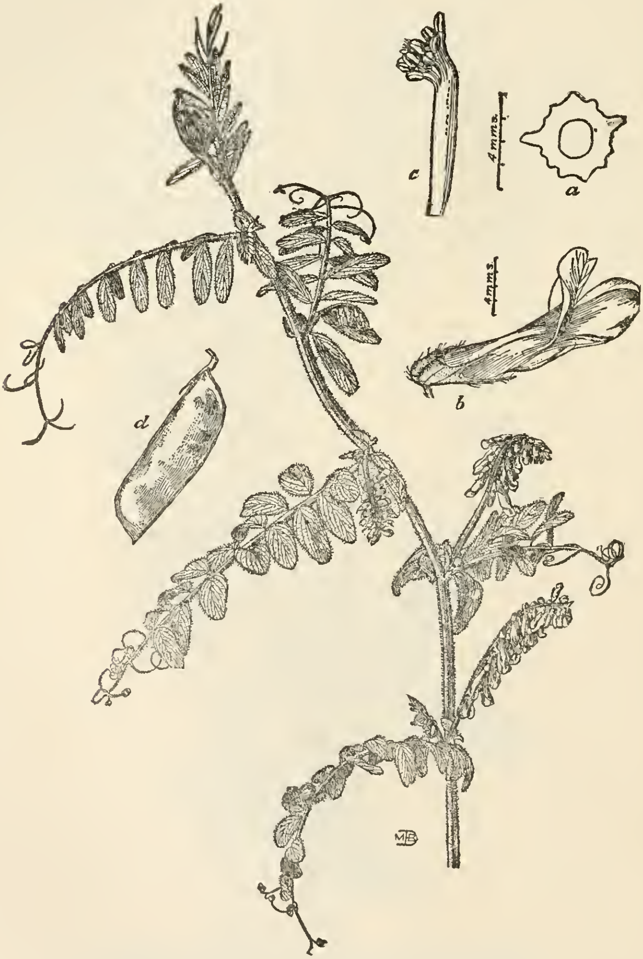

Fig. 284. Hairy Vetch (*Vicia villosa*). Cultivated as a forage plant. (U. S. Dept. Agr.)

of Europe and Asia, and naturalized in the U. S. contains a yellow coloring principle. The seeds of *Entada scandens* are used in the Samoan Islands in playing games. The *Pithecolobium dulce* contains a pulpy pod which is eaten. The plant is good fodder. Guava (*Inga vera*) is grown as a shade tree and as a substitute for coffee. It is not to be confused with the fruit producing guava (*Psidium guajava*). Important forage plants not previously mentioned are red clover (*Trifolium pratense*), native of Europe and used extensively in northern United States; alsike clover (*T. hybridum*), white clover (*T. repens*), well known as a forage plant and a good honey plant, *T. alexandrinum* the great forage crop of Egypt, known as the Beresem, Japan clover (*Lespedeza striata*) a well known forage plant of the South, French honeysuckle (*Hedysarum coronarium*) an ornamental plant, native to Spain, also used as a forage plant of Europe and Western Asia, *Desmodium triflorum* used as a forage plant in the tropics, Florida beggar weed (*Desmodium tortuosum*) of India, alfalfa (*Medicago sativa*) of Europe and Western Asia, the vetches (*Vicia villosa* and *V. sativa*), lupines (*Lupinus albus*) cultivated for forage purposes, besides many valuable native forage plants like the *Hosackia Purshiana,* the wild pea (*Lathyrus venosus*) etc.

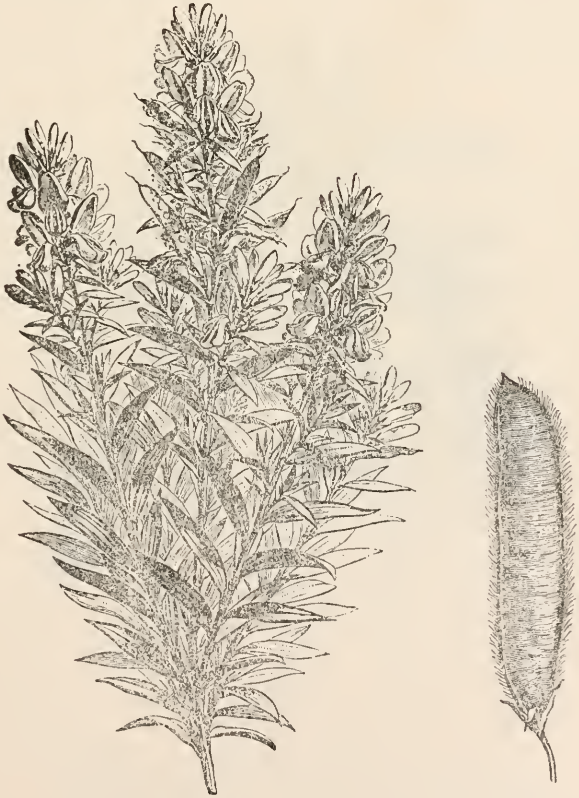

Fig. 285. Dyer's Broom (*Genista tinctoria*). Contains a yellow coloring matter. (After Faguet.)

Prof. N. E. Hansen through his exploration has brought into prominence the yellow-flowered alfalfas from Siberia, *Medicago ruthenica* and *M. platycarpa*, and some of the hardy alfalfas are apparently hybrids between *M. sativa* *M. falcata*. C. V. Piper * calls attention to a number of valuable leguminous forage plants that should be cultivated in this country, such as the Lyon bean (*Stizolobium Lyoni*). The Kudzu (*Pueraria Thunbergiana*) a woody native of Japan, is much used as a forage plant in that country and has been cultivated in Florida. The Guar (*Cyamopsis tetragomoloba*) is an East India annual legume and is said to be very drouth resistant. Tangier pea (*Lathyrus tingitanus*) is a native of Northern Africa. It is excellent and said not to be poisonous like the other species. The moth bean (*Phaseolus aconitifolius*) is used for food in India and is said to be a splendid forage plant. The Adzuki bean (*Phaseolus angularis*) native of southern Asia is used for food in China, Japan and India, and is said to possess vaulable qualities as a hay plant. The Kulti (*Dolichos biflorus*) native to India is said to give promise in the semi-arid regions in Texas as a valuable forage plant. Under the Vetches the more recent introductions that give promise are the scarlet vetch (*Vicia fulgens*) of Northern Africa, the black purple vetch (*V. atropurpurea*) of Algeria and the woolly pod

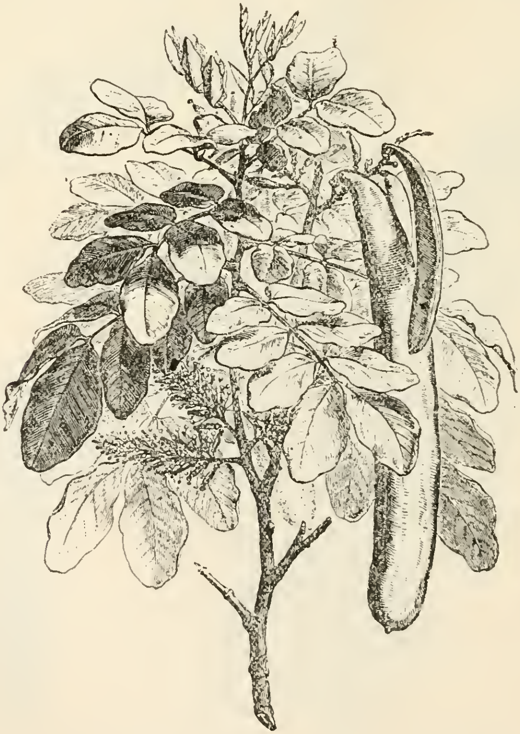

Fig. 286. Carobtree, or St. John's Bread (*Ceratonia siliqua*). The fruit is edible and is supposed to be the "locust" of Biblical history. (After Faguet.)

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* Yearbook U. S. Dept. of Agr. 1908-245.

vetch (*V. dasycarpa*) of the Mediterranean region, the Carob tree or St. John's bread (*Ceratonia siliqua*) is a small tree of the Mediterranean region, the pods of which contain much mucilage of a sweet nature from which syrup was made, and is supposed to be the locust which John the Baptist lived upon in the Wilderness and is used as food; and cattle also relish it. Manna (*Alhagi maurorum*) is a dwarfed, thorny, shrubby plant which produces a kind of manna. The locust trees of the West Indies, or Courabaril (*Hymenaea Courbaril*) produces a hard timber. The pods contain bean-like seeds embedded in a white spongy mass. The Zamang (*Pithecolobium Saman*) is a large tree of Venezuela which produces thick, flat pods, containing a sweet pulp commonly used by cattle and horses for food but which are liable to cause internal disorder. The honey locust of eastern North America (*Gleditschia triacanthos*) produces a hard wood. The pod contains a gummy sweetish substance much relished by stock. The pods of the mesquite tree (*Prosopis juliflora*), native to Texas, are used by stock. The Kentucky coffee tree (*Glymnocladus dioica*) is native to the Mississippi Valley and it produces a broad, tough pod which contains large, hard seeds. The pod contains a sweetish, disagreeable and nauseating material more or less poisonous. The hard wood is durable. The seed of hairy vetch (*Vicia hirsuta*) is a common impurity in grain seed. The plant is used for forage. The seeds of *Castanospermum australis* are used in New South Wales in the production of starch. The seed of the coffee astragalus (*A. baeticus*) is said to produce, when roasted, the true coffee flavor, and is much used in Sweden.

Many of the species of the order are ornamental, among which may be named the Judas tree or red bud (*Cercis Siliquastrum*); the *Caraganas,* shrubs with beautiful yellow flowers; the broom (*Cytisus scoparius*) of Europe naturalized along the sea coast, also used in medicine; the black locust (*Robinia Pseudo-acacia*), commonly planted as an ornamental tree. The laburnum (*Laburnum anagyroides*) is an ornamental tree with poisonous seeds and hard wood, used for turned work. The wisteria (*Wisteria speciosa*) a hardy species of the southern states and *W. Chinensis* of China, are cultivated as far north as central Iowa. The seeds of several species of the order are used for making necklaces, among these are the red seeds of the coral tree (*Erythrina Corallodendron*) of the West Indies, the crab's eye (*Abrus precatorius*) and the *Ormosia dasycarpa.* The Jequirity seed (*Abrus precatorius*) is used as a weight in India, according to Dr. Spafford, each seed weighing approximately 1 gram.

Medicinal Plants. Of the medicinal plants, in this family, the most important only will be mentioned here. The broom (*Cytisus scoparius*), native to Europe, is used as a diuretic and purgative. Fenugreek (*Trigonella Foenum-graecum*) was formerly used in medicine, but the powdered seeds are now used as an ingredient of curry powder and also in the preparation of stock foods; they have a characteristic odor and bitter taste. Licorice root (*Glycyrrhiza glabra* and var. *glandulifera* (Russian), native to the warmer regions of Europe and extending eastward into Central Asia, is made into extract of licorice which is used to cover the flavor of nauseous medicines and contains the glucoside *glycyrrhizin.* Cowhage (*Mucuna pruriens*) is a lofty climbing plant with dark purple flowers of the size of the sweet pea; pods from 2-4 inches long, covered with rigid, pointed, brown hairs, which if touched, enter the skin and cause itching. The plant is used for the expulsion of intestinal worms, the hairs being mixed with honey and molasses. The young pods are used as food. The Calabar or ordeal Bean (*Physostigma venenosum*) is a climbing perennial plant resembling the scarlet runner and is native to tropical western Africa. It was formerly used by the natives to produce poisoning and is also an antidote against *strychnin* poisoning. The seeds contain several poisons, among them the alkaloids *physostigmin* $C_{15}H_{21}N_3O_2$ which contracts the pupil of the eye, *calabarin* a tetanizing principle, and *eseridin* $C_{15}H_{23}N_3O_2$ a purgative. The wood of Araroba (*Andira araroba*) is very bitter and is used in ointments. Balsam of Tolu (*Myroxylon toluiferum*), a native of Veneuzela and New Granada, is used as an ingredient in lozenges and contains a volatile oil *tolene* $C_{10}H_{16}$.

Logwood (*Haematoxylon campechianum*) is a spreading tree, native to Central America and Honduras, the bark of which is used for dyeing and staining, also for domestic purposes, such as in chronic diarrhoea, and contains *heamatoxylin* $C_{16}H_{14}O_6$ and *heamatein* $C_{16}H_{14}O_6$. Senna leaves are derived from the leaves of Cassia (*C. acutifolia* and *C. angustifolia*), the former being found in Nubia and the latter in southern Arobia and India. Senna leaves are used in medicine as a purgative and contain *cathartic acid, chrysophan* and two bitter principles *sennacrol* and *sennapicrin.* Several of our native species of *Cas-*

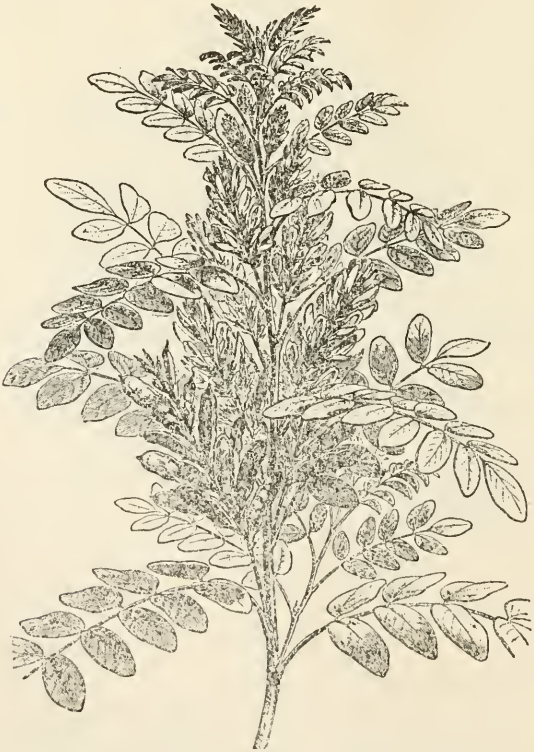


Fig. 287. European Licorice (*Glycyrrhiza glabra*). (After Faguet).

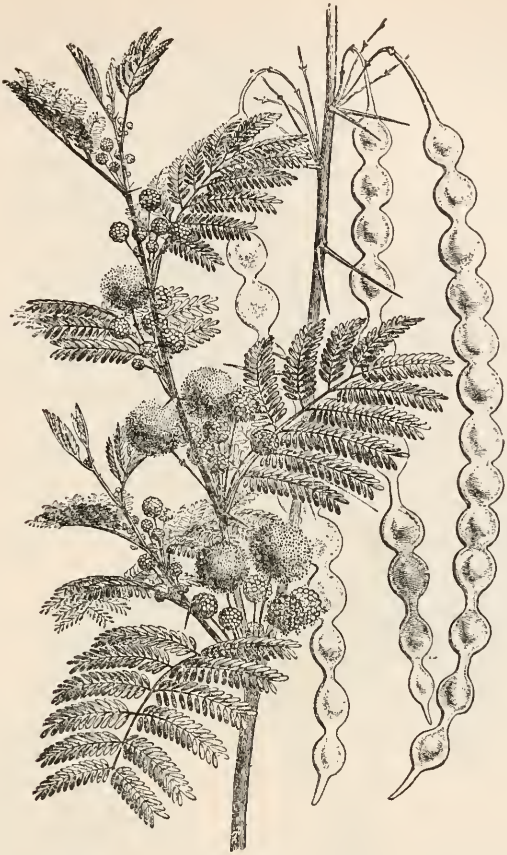


Fig. 288. Acacia (*Acacia arabica*). Flowering and fruiting branch. The source of gum arabic. (After Faguet.)

sia like the partridge pea (*C. Chamaecrista*), produce scours in sheep because of their purgative properties. The purging cassia (*C. Fistula*) is a tree indigenous to India. The pulp of the pod is a mild laxative. *Clitoria ternatea* of the Pacific Islands is a powerful cathartic. Tamarind (*Tamarindus indica*) a large, handsome tree indigenous to tropical Africa, is now widely distributed in other tropical countries. The fruit is used in medicine as a mild laxative and also in making a drink. It contains citric, tartaric, and other organic acids. The pulp and seeds are also eaten; the latter, when boiled, make a tenacious glue. The leaves and flowers are used as mordants in dyeing. Copaiba balsam (*Copaifera officinalis*) is a native to South Africa. The balsam is collected by Indians and used because of its stimulating action on the mucous mebmrane. It contains several acids, among them *copaibic acid,* $C_{20}H_{30}O_2$. Gum Arabic is obtained from *Acacia arabica,* the finest product coming from several species of the genus *Acacia* (*A. Senegal*), a plant well known to ancients. It possesses no real medicinal value. Catechu (*Acacia Catechu*), a small tree with thorny branches, found in tropical eastern Africa, is used in medicine as an astringent. Under another name, Cutch, it is used in medicine because of its astringent properties. The resin from Cutch is made into cakes used for dyeing and tanning. Cutch contains *catechol* $C_6H_6O_2$ and *catechutannic* acid.

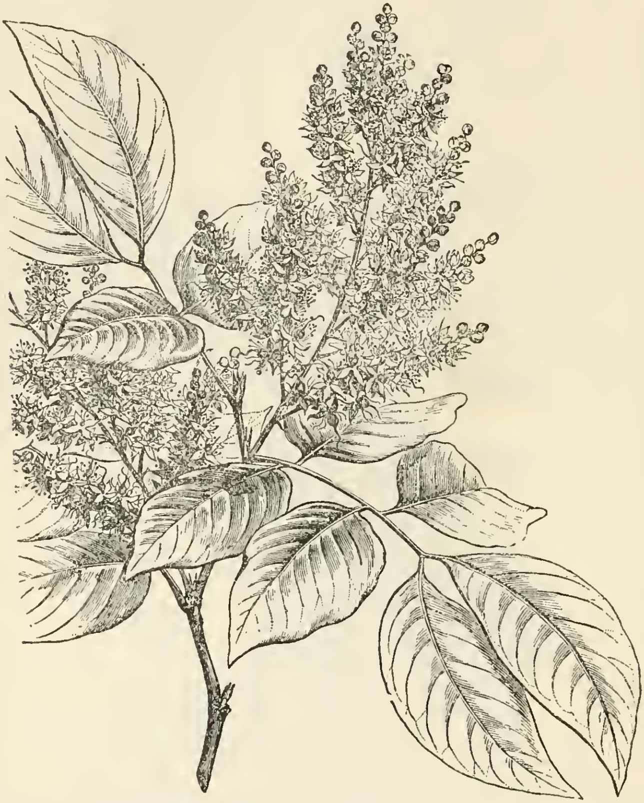


Fig. 289. Copaiba Balsam (*Copaifera officinalis*). Used medicinally. (After Faguet.)

Gum tragacanth (*Astragalus gummifer*) native to western Asia, is a spiny shrub with yellow flowers and is used to give consistency to lozenges; it contains *traganthin*, $C_6H_0O_5$ and *arabin*.

Poisonous and medicinal plants. Most of the substances occurring in the poisonous plants are mentioned under the species described. Many of the *Leguminosae* contain alkaloids; few of these are, however, found in *Mimoseae*, although alkaloids have been found in *Acacia tenerrima, Albizzia lucida*, and *Pithecolobium Saman* which are Mimosae. Of the *Papilionaceae*, the *Sophoreae, Podalyrieae* and *Genisteae* frequently contain alkaloids. *Ulexin*, found in seed of the *Ulex europaeus, sophorin*, in *Sophora speciosa*, and *baptitoxin* are identical with *cytisin. Matrin* $C_{15}H_{24}N_2O$, an alkaloid, resembling *lupanin* occurs in the root of *Sophora augustifolia* *Anagyrin* $C_{15}H_{22}NO_2$, and *cytisin*, both occur in the seeds of *Anagyris foetida, Baptisia* and many other genera.

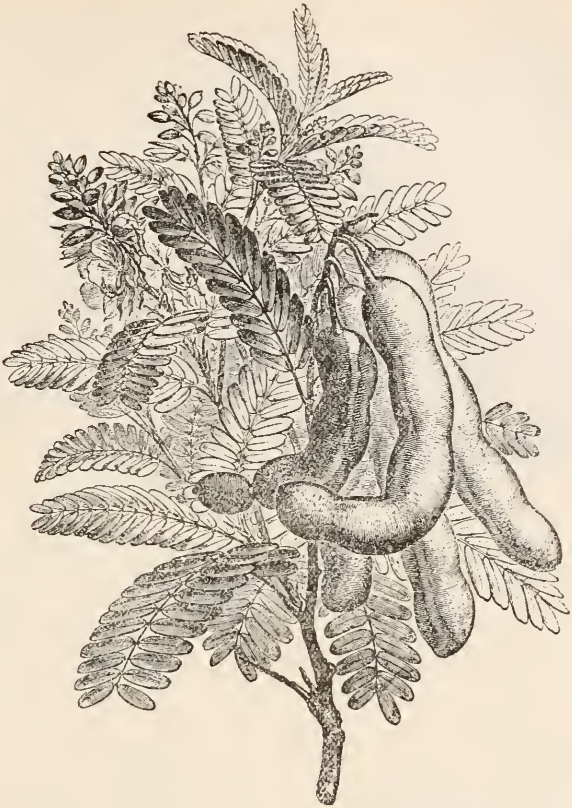


Fig. 290. Tamarind (*Tamarindus indica*). Fruit, flowers and leaves. Fruit used in making a refreshing drink; seeds furnish a glue. (After Faguet.)

Retamin $C_{15}H_{26}NO_{20}$, is obtained from the young branches of *Genista sphaerocarpa.* The seed of *Trigonella Foenum-Graecum* contains *trigonellin* $C_7H_7NO_2$; the same alkaloid is said to also occur in the pea, hemp and oats. *Physostigmin* $C_{15}H_{21}N_3O_2$, or *eserin* occurs in the ripe seed of *Physostigma venenosum.* The so-called *calabrin* is a secondary product; *Robinia Nicou* is said to contain *nicoulin. Pancin* $C_{27}H_{39}N_5O_5$ is found in the fruit of *Pentaclethra macrophylla.*

Quite a number of the Leguminosae also contain glucosides. One of the earliest discoveries made in connection with glucosides was of *glycyrrhyzin* found in some species of *Astragalus, Abrus prectorius,* and the root stock of *Polypodium vulgare* and other plants. The root of our wild licorice also contains a glucoside to the extent of 8.53 per cent. *Glycyrretin,* found in licorice, has the formula $C_{16}H_{24}O_6$.

Ononis spinosa contains a glucoside *ononid* and a second glucoside, *ononin,* $C_{30}H_{34}O_{13}$. *Lupinin,* $C_{29}H_{24}O_{16}$, is a glucoside found in the seedlings of *Lupinus luteus,* which through hydrolysis forms *lupigin,* $C_{17}H_{12}O_6$. *Gastrolobin* is found in the leaves and young branches of *Gastrolobium bilobum; bap-*

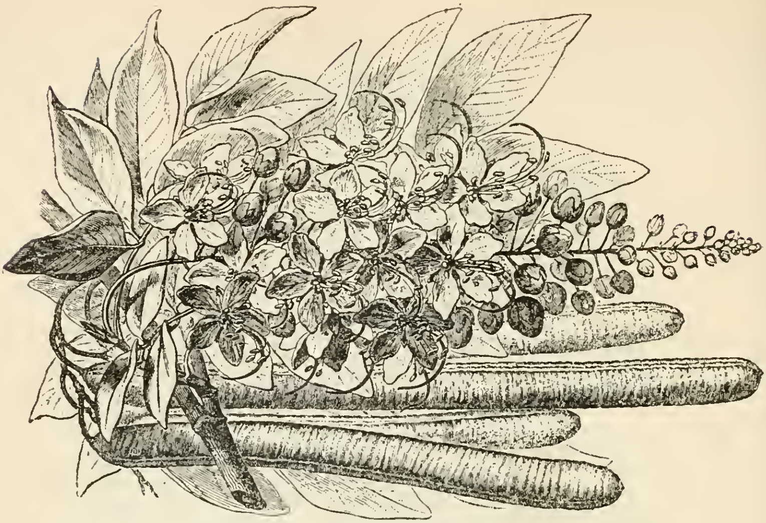


Fig. 291. Purging Cassia (*Cassia Fistula*). Flowering and fruiting branch. The pulp of the pod is a mild laxative. (After Faguet.)

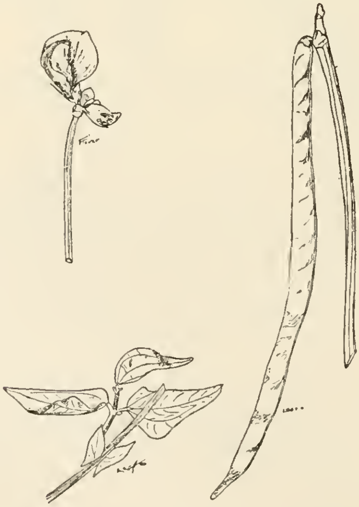


Fig. 292. Cow Pea (*Vigna Catjang*). A well known forage plant of the South. To the right a legume; to the left a flower and a part of a branch in the lower left hand corner. (W. S. Dudgeon.)

tisin, $C_{26}H_{32}O_{14}$, occurs in *Baptisia*; and *tephrosin,* a poisonous substance in *Tephrosia toxicaria.* A very toxic unnamed glucoside, $C_{33}H_{30}O_{10}$, occurs in the bark and root of *Derris elliptica, Mundulea suberosa,* and *Lonchocarpus violaceus.* Power, however, failed to find this glucoside in *Derris uliginosa. Turboin,* $C_{34}H_{32}O_{10}$, occurs in *Tephrosia toxicaria. Gallotannic acid,* $C_{14}H_{10}O_9 +_2H_2O$ so called, occurs in the pod of *Caesalpinia coriaria.* The bark of certain species of Acacia contains 30 per cent of tannic acid. The wood of *A. Catechu* is colored red by *catechin,* a crystallizable substance.

Lindley in the earlier edition of his Vegetable Kingdom, states, that the plants of this family are on the whole wholesome and nutritious, and later declares that the family must be considered poisonous. The species used as food must be considered an exception.

In Australia there are several members of this family that are poisonous. Dr. Gray in an American Agriculturist of Oct., 1878, says:

> What a pity that our cattle are not better acquainted with the corrected rule. In Europe and in the Atlantic States, no harm is known to come to cattle from want of proper discrimination. But when European flocks were taken to Australia and to pastures and forage almost wholly new, thousands of sheep perished in the Swan River Valley Colony in consequence of cropping the leaves of some leguminous plants to which they were attracted. What made the matter worse for the botanists, was that the very plants which did the mischief had been recommended by one of them (Mr. Preiss, a German) as the best thing the Agricultural Society could cultivate, as artificial food for stock. But another botanist, Drummond, a canny Scotchman, made some experiments, that proved that the people were right in charging the damage to these very species (of Gastrolobium) which the German botanist, on general principles, expected to be innocent and useful.

The Australian *Gastrolobiums* are all more or less poisonous, Baron Müller having long ago reported *Gastrolobium grandiflorum* as poisonous. The *G. calycinum* known as the York road poison has a toxic base *cygnin, cygnic acid* $C_{10}H_{10}O_4$ which decomposes and forms *gastrolobic acid* $C_7H_{10}O_5H_2O$. The following species are recorded as poisonous by Maiden in Australia: *G. trilobum, G. polystachyum, G. grandiflorum,* poisonous to sheep and goats, the seeds being especially toxic but not to pigeons. The diseased animals have difficulty in breathing, then they stagger and die, death occurring in from 3-6 hours. The poison enters the circulation, stops the action of the lungs and heart. The raw flesh is said to poison cats, and the blood, dogs. The boiled or roasted flesh is, however, eaten by the natives and is not injurious. The blossoms are very poisonous. The *Mirbelia racemosa* is also poisonous to sheep, cattle, and goats. Two species of *Goodia,* according to Maiden, are poisonous, the *G. lotifolia* and *G. medicaginea.* These plants produce what locally goes by the name "black scours." The animals become weak, emaciated, and die. The *Gastrolobium* and *Crotalaria* are stock killers in Australia though used as forage in South Australia. Maiden reports that the bean tree (*Castanospermum australe*) is poisonous to stock, especially the beans; when cooked, however, they are eaten by the Abyssinians. The box poison (*Oxylobium parviflorum*) is said to be a very poisonous plant to stock. The *Gompholobium uncinatum* is very injurious to sheep in New South Wales. The *Swainsona Greyana* and *S. coronillaefolia* are poisonous. Sheep that eat them are called indigo-eaters. Both species act much like the loco weeds of the United States, "sheep go wrong in the head;" horses also act strangely. "The eyes stand out of their heads." This disease is identical with the "Nenta" disease of South Africa and the "Pea eating" disease of Australia. The South African disease is produced by *Lessertia.* The symptoms from *Astragalus mollissimus, Gompholobium, Sophora secundiflora, Cytisus proliferus,* are all cerebral. Mac Owen regards them all as belonging to the same category and that *Lathyrism* caused by *Lathyrus sativus* is allied to them. That the well known forage plants *Lotus corniculatus,* and *L. australis,* of excellent repute, are often injurious to stock, but perhaps only from causing indigestion, as stated by Maiden, is worthy of note in this connection. Moussu and Desaint report the deaths of a flock of 54 sheep due to poison resulting from eating another plant of this order, *Galega officinalis*; 80 others in the same flock were badly affected. Ecchymoses were found in the walls of the alimentary tract and in the fatal cases a large amount of serum had collected in the pleural cavity. In subsequent experiments, it was found that 3 kg. of *G. officinalis* was sufficient to poison a sheep; the plant, however, seems not to be poisonous to rabbits. It is of interest to note that the genera *Robinia, Indigofera, Wisteria, Caragana, Colutea, Swainsona, Galega, Lessertia, Astragalus,* and *Sesbania,* all of which contain poisonous species, many of which are exceedingly toxic, belong to the tribe *Galegeae* of this family. *Glychyrrhiza* of the same tribe is not poisonous nor are all of the species in genera like *Astragalus, Caragana,* etc.

The *Erythrophlaeum guineense* contains an alkayoid *erythophlein* which acts like *digitalin* and *picrotoxin.* The Indigo of Australia (*Indigofera australis*) is regarded as poisonous in Australia. The *Lathyrus sativus, L. cicera,* and *L. clymneum* are poisonous but the active principles have not been isolated. Of other poisonous genera *Robinia, Baptisia, Gymnocledus, Thermopsis,* may be mentioned, but the treatment will be given more at length in another connection.

According to Dunstan and Henry, *Lotus arabicus,* when moistened with water and crushed, produces prussic acid. The glucoside *lotusin* is converted by the enzyme *lotase* into prussic acid. We may mention here that many of the spiny Acacias (*A. palleus*) of Australia may be injurious in a mechanical way.

The poisonous substance of Jequirity (*Abrus precatorius*) is a toxalmumin called *abrin* (found also in *Cassia hispidula* of Mexico) which is easily decomposed by heat. Behring has produced an antitoxin against the *abrin* or *A. precatorius.* The beans when cooked are eaten in Egypt.

A poisonous resin has been found in *Wisteria chinensis,* and a glucoside *wisterin; Colutea arborescens,* a well known southern European ornamental plant is poisonous, the leaves being so strongly purgative that they are frequently substituted for the genuine Senna. European authors list it among the poisonous plants.

The *Tephrosia purpurea* of Australia is poisonous to stock, and is used to stupefy fish. A large number of other plants of the order are used as fish poisons. Mention may be made of *Derris, Abrus* and *Clitoria*; others are mentioned in Part I. Some like *Afzelia* and *Pithecolobiun* are used as arrow poisons. The seeds of the jequirity plant (*Abrus precatorius*) are much used in India for the purpose of poisoning especially in criminal cases of cattle poisoning, less than 2 grams of the powdered seed causing death in 48 hours. The usual method of the "Chamar" or "Skinner" caste is to prepare small spikes, first soaking the seeds in water, then pounding them, and drying them in the sun; they are then sharpened upon a stone attached to a handle, and driven under the skin and left there. Daggers are rendered poisonous by being dipped into the powdered seed.

According to Greshoff the leaves and also the seeds of *Cassia marylandica* contain saponin; leaves of *Prosopis juliflora, Galega officinalis, Psoralea macrostachya* as well as the seeds contain saponin. *P. tenuiflora* is regarded as poisonous and is avoided by cattle.

Corolla not papilionaceous or only slightly so, endosperm copious.
Flowers perfect; leaves abruptly pinnate..........................1 Cassia.
Flowers polygamous or dioecious.......................2. Gymnocladus.
Corolla papilionaceous without or with endosperm; stamens usually 10, usually diadelphous or monadelphous.
Stamens 10, distinct.
Leaves palmately 3-foliolate.
Pod inflated ....4. Baptisia.
Pod flat ....3. Thermopsis.
Leaves pinnate ....5. Sophora.
Stamens monadelphous, diadelphous, or rarely distinct.
Anthers of 2 forms, stamens monadelphous.
Leaves simple.
Pod inflated ....6. Crotalaria.
Pod flat.
Leaves 1-3-foliolate ....8. Cytisus.
Leaves usually 7-11 foliolate ....7. Lupinus.
Anthers all alike.
Leaves generally 3-foliolate.
Flowers in racemes; pods coriaceous............9. Melilotus.
Flowers in heads; pods membranous.........10. Trifolium.
Flowers in spikes or heads; pods curved.........10. Medicago.
Leaves pinnately foliolate.
Leaves not tendril bearing; plants not climbing.
Herbs with glandular dots.......................12. Psoralea.
Herbs without glandular dots; pods flat.
Leaves odd pinnate.
Herbs. Flowers large.........................13. Tephrosia.
Trees or shrubs ....12. Robinia.
Leaves evenly pinnate ....15. Sesbania.
Pod turgid inflated.
Leaflets not toothed, or only at the apex.
Keel tipped with an erect point........17. Oxytropis.
Keel not tipped with an erect point.....16. Astragalus.
Leaflets toothed all round ....20. Cicer.
Herbaceous plants; leaves with tendrils or climbing.
Leaves with tendrils; style bearded at the apex.........18. Vicia.
Style bearded down one side ....19. Lathyrus.
Herbaceous climbers; not tendril bearing.........................21. Phaseolus.

1. *Cassia* L.

Herbs, shrubs, or in tropical regions, trees, with abruptly pinnate leaves; calyx of 5 sepals united at the base; petals 5; somewhat unequal, spreading, imbricated, and clawed; stamens usually 10, or 5, often unequal, and some imperfect; anthers all alike, or the lower larger, opening by 2 pores at the apex;

ovules numerous. About 270 species, mostly in warm and temperate regions. A species well known in medicine is Senna (*C. acutifolia* and *C. angustifolia*) with leaves which are laxative.

Cassia Chamaecrista L. Partridge Pea

An annual, spreading, 1 foot long; leaves with a sessile gland on the petiole; leaflets of 10-15 pairs; flowers large, showy; petals yellow, with a purple spot at the base; anthers 10, elongated, and unequal, 4 yellow, the others purple.

Distribution. In dry or sandy soil from Maine to South Dakota, Texas to Florida.

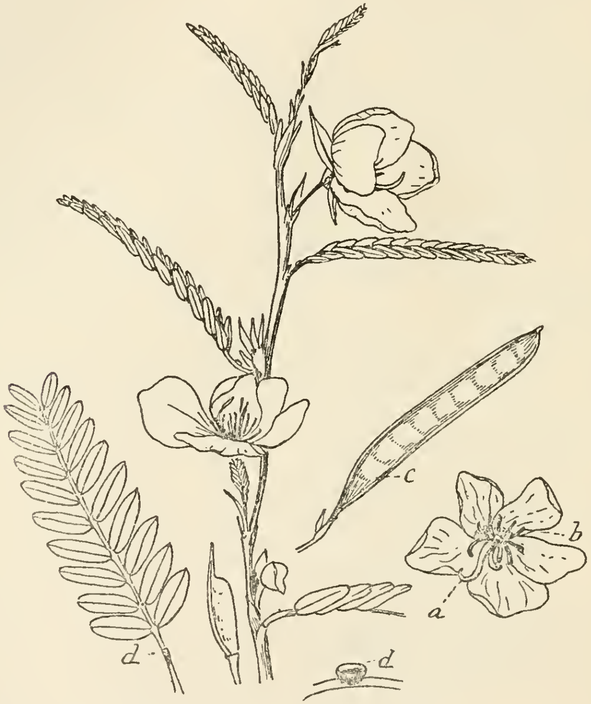


Fig. 293. Pea Partridge (*Cassia Chamaecrista*). c. Pod. a. Pistil. b. Stamens. (C. M. King)

Poisonous properties. This plant is common in hay and when the seeds are consumed in large quantities, has a cathartic action. Cases of mild poisoning to sheep have been reported to the writer. *C. marilandica,* a plant with curved pods that are somewhat hairy at first, possesses similar properties. *C. hispidula* contains *abrin.*

2. *Gymnocladus,* Lam.

Trees with large, bipinnate leaves, and showy, white, dioecious or irregular, polygamous flowers; calyx elongated-tubular below; 5-cleft, the lobes narrow, nearly equal; petals 5 (rarely 4), oblong or oval; stamens 10, distinct, short,

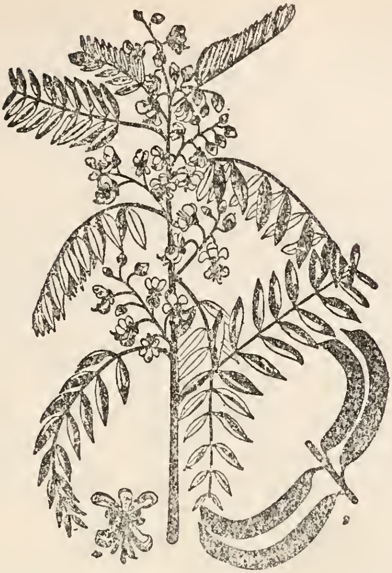


Fig. 294. Wild Senna (*Cassia Marylandica*). 1. Flower. 2. Pods. A plant growing in the Eastern Atlantic States as far south as North Carolina. Laxative like the Common Partridge pea. (Selby, Ohio Agrl. Exp. Stat.)

inserted on the petals; ovary rudimentary, or none in the staminate flowers, sessile and many-ovuled in the pistillate; pod oblong, thick, large, and coriaceous.

Gymnocladus dioica (L.) Koch. Kentucky Coffee-tree

A large tree with rough bark; leaves large and ample, 2-3 feet long; 7-15 leaflets, ovate or acute; glabrous or pubescent on the veins beneath; racemes many-flowered; flowers slender-pedicelled; seeds hard, ½ inch across, imbedded in a sweet, but disagreeable, and somewhat mucilaginous, material.

Distribution. From Western New York to Pennsylvania, Eastern Nebraska, and Arkansas.

Poisonous properties. Cases of poisoning are not uncommon. The alkaloid *cytisin* $C_{11}H_{14}N_2O$, a crystalline, rather bitter, and caustic substance which causes dilation of the pupil, is reported to have been found, according to Chesnut, in the leaves and soft pulp of the fruit of the coffee bean. The pulp has long been used, when mixed with milk, to poison flies. In speaking of the symptoms and treatment, Prof Chesnut says:

> Few accidental cases of poisoning arise, but the pulp, in one instance, caused severe illness in a woman who ate a small quantity, mistaking it for that of the honey locust (*Gleditsia triacanthos*), which is frequently eaten by children. The symptoms were not fully noted at the time, but are described from memory as conspicuously narcotic. The effect began within five minutes and lasted several hours. The treatment should probably be the same as that for laburnum, viz., emetics, stimulants, injections of coffee, and an alternately hot and cold douche to the head and chest.

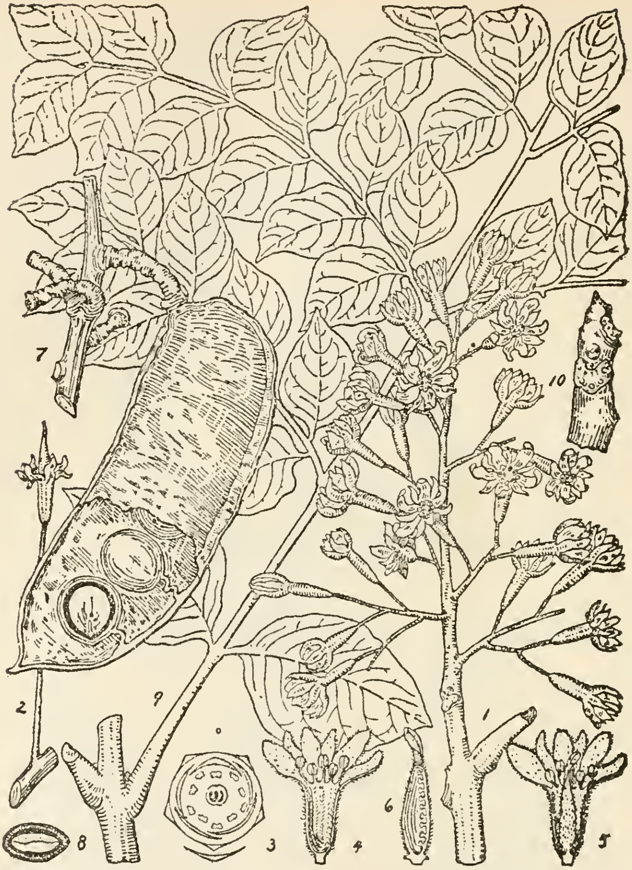


Fig. 295. Kentucky Coffee Tree (*Gymnocladus dioica*). . Inflorescence from staminate tree. 2. Pistillate flower. 3. Diagram of flower. 4. Longitudinal section of staminate flower. 5. Pistillate flower with a portion removed. 6. Pistil with a section of ovary removed. 7. Portion of branch bearing a single fruit, showing seed and embryo. 8. Cross section of seed. 9. Portion of leaf. 10. Portion of winter branch. 1, 2, 7, 8, 9, 10, one-half natural size. (M. M. Cheney in Green's Forestry in Minnesota.)

3. *Thermopsis* R. Br.

Perennial with finely oppressed pubescence, 2-3 feet high; leaves rhombicolate leaves and foliaceous stipules; flowers large, yellow or purple, borne in racemes; calyx bell-shaped or short-turbinate, with equal and separate lobes or the upper united; standard nearly orbicular, as long as the oblong wings and the keel; stamens 10, separate and in-curved; pistils sessile or short-stalked, frequently flat, linear, oblong or curved, ovules numerous. A small genus of about 15 species of North America and Asia.

Thermopsis mollis (Michx.) M. A. Curtis. Alleghany Thermopsis

Perennial with finely appressed pubescence, 2-3 feet high; leaves rhombic-lanceolate, 1-3 inches long, entire and nearly sessile; stipules ovate or lanceolate;

racemes chiefly terminal; flowers yellow, pod short-stalked and narrow and somewhat curved.

Distribution. In the mountains of Virginia, North Carolina and Tennessee.

Thermopsis rhombifolia Richards. Prairie Thermopsis.

An erect perennial from 1-2½ feet high, appressed, silky pubescent; stem angular; leaves with broad conspicuous stipules; leaflets obovate, at length nearly glabrous, bracts oval; flowers yellow, in a rather short raceme of few flowers; pod linear and curved, spreading, several seeded.

Distribution. In sandy soil and foot hills of the mountains from Manitoba to South Dakota, Nebraska and Kansas, west to the Rocky Mts., and in Utah, Wyoming and Montana.

Poisonous nature. This plant is very common in the foot hills, and is supposed to produce poisoning of stock. It is often consumed by sheep. It is said that the seeds of the plant are poisonous and the Canadian Department of Agriculture reports several cases of poisoning to children where the seeds were eaten. *T. montana* is a species occurring from western Nebraska anl Kansas to the Pacific Coast. Species of Thermopsis are said to contain *cytisin.*

4. *Baptisia* Vent.

Perennial herbs with palmately 3-foliolate, or rarely simple leaves; basal sheathing scales; flowers large, in racemes; calyx 4-5-toothed; corolla with a

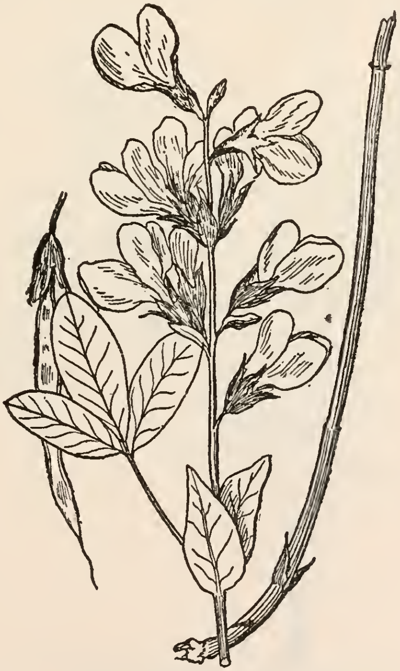


Fig. 296. Yellow-flowered Bitter weed (*Thermopsis montana*). Plant is exceedingly bitter. (From U. S. Dept. Agr.)

large standard, but not longer than the wings; stamens 10, distinct; pods stalked, roundish, oblong, inflated, and many-seeded; seeds often spreading and rattling. About 16 species in Eastern North America.

Baptisia australis (L.) R. Br. Blue False-Indigo

Tall, smooth, stout perennial 4-5 feet high; leaves short-petioled; leaflets oblong or oblanceolate, obtuse; stipules conspicuous, persistent; racemes terminal, loosely flowered; 1-2 feet long, erect; flowers blue.

Distribution. From Western Penn. to Arkansas and Kansas to Ga.

Baptisia tinctoria (L.) R. Br. Yellow or Indigo Broom

A smooth, slender perennial herb 2-3 feet high; leaves nearly sessile; leaflets obovate or oblanceolate, sessile or nearly so; racemes few-flowered; flowers yellow.

Distribution. In dry soil from Maine to La., west to Minn.

Poisonous properties. Baptitoxin which is probably the same as *cytisin* occurs in *Baptisia tinctoria.* The glucoside *baptisin* $C_{26}H_{32}O_{14}$ occurs in some species of the genus.

Dr. Millspaugh states that disturbances produced by taking considerable quantities of the tincture are:

> Vertigo; dull, heavy headache with weakness and weariness of body, and tendency to delirium; soreness and lameness of the eyeballs, with hot, flushed face; tongue coated white, yellow, or yellowish-brown; loss of appetite; nausea, and burning in the stomach;

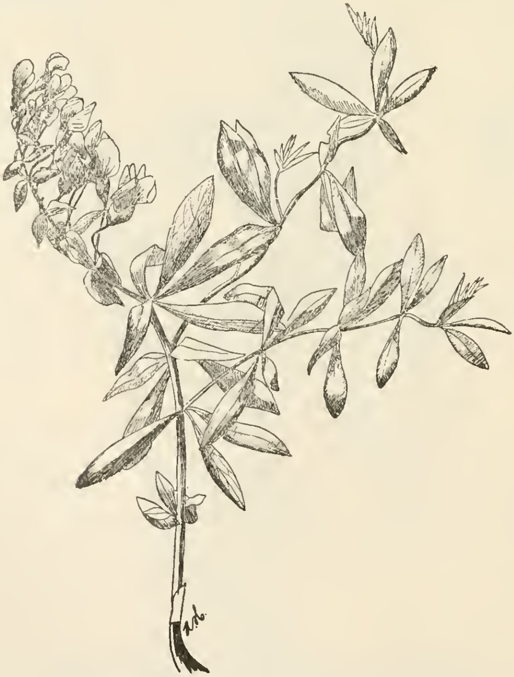


Fig. 297. Wild Indigo (*Baptisia bracteata*). Said ot be poisonous. (Ada Hayden.)

dull pains in the region of the liver, especially at the site of the gall-bladder; face sallow, with burning cheeks; constant pain and aching in the abdomen, followed by marked distention, and soreness on pressure.

According to Dr. Hughes, Baptisia excites true primary pyrexia in the human subject. This pyrexia is very much like that of the early stages of typhoid.

Baptisia leucantha T. & G. Large White Wild Indigo

A smooth, erect perennial herb, petioled leaves; leaflets obtuse, rounded, or sometimes slightly emarginate; stipules deciduous; racemes lateral; flowers white or cream color. Prairies and alluvial soils, Ont. to Minn., to Fla. and La.

Poisonous properties. According to Hyams it is a violent emetic and cathartic when taken in large doses and in small doses a mild laxative.

Baptisia bracteata (Muhl.) Ell. Large-bracted Wild Indigo

Perhaps more common in sandy soil in the west than B. leucantha. It is also shorter and flowers earlier in the season. Prairies, Mich, to Minn., La., Tex.

Poisonous properties. Dr. Schaffner states that the blue wild indigo and the yellow wild indigo are emetic, and that the latter species is regarded as

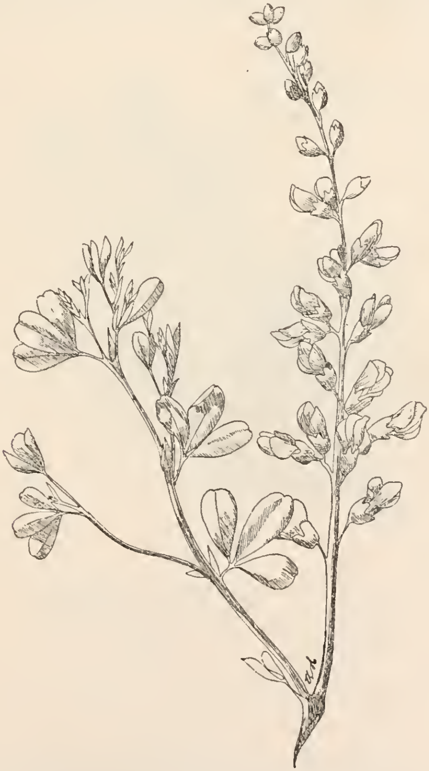


Fig. 298. Wild Indigo (*Baptisia leucantha*). This plant is a native of prairies and alluvial soils. Said to be poisonous. (Ada Hayden.)

poisonous. The taste of the plant is rather disagreeable, and it is not generally eaten by stock.

5. *Sophora* L.

Shrubby or herbaceous perennials; leaves odd pinnate with numerous leaflets; flowers white, yellow or violet in terminal racemes or panicles; calyx bell-shaped, with short teeth, standard rounded or obovate; wings obliquely oblong; keel oblong, nearly straight; stamens all distinct or nearly so; pistil short-stalked; style incurved; pod stalked and terete, constricted between the seeds. About 25 species, of warm and tropical regions.

Sophora sericea Nutt. Silky Sophora

A low perennial herb from 6-12 inches high, more or less silky canescent; stipules subulate, deciduous, leaflets about 21, elliptical or cuneate oval; flowers in short terminal racemes; nearly sessile; corolla white, pod dry, leathery, finely pubescent and few seeded.

Distribution. The prairies of Nebraska and Colorado to Texas and Arizona.

Poisonous properties. Mr. Chesnut says of this plant:

> The silky sophora, of the Southern Great Plains region, has been somewhat vaguely reported as one of the plants that "loco" horses in that region. The seeds contain a very poisonous alkaloid.

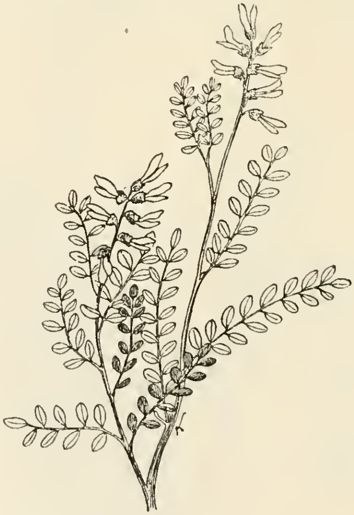


Fig. 299. Silky Sophora (*Sophora sericea*). A plant of the plains and thought to be poisonous. (Charlotte M. King.)

Sophora secundiflora DC. Coral Bean

A stout shrub or small tree, with deep green leaves of about 9 elliptical, oblong, obtuse, coriaceous leaflets; terminal racemes of showy violet, fragrant flowers; and large, woody pods 3-5 inches long, containing 3-4 round red beans as large as small marbles.

Distribution. Common from the Gulf Coast to the Pecos and less abundant n mountain canons to New Mexico. It is mostly shrubby, but becomes a tree 30 feet high and forms groves in the vicinity of Matagorda Bay.

Poisonous properties. Mr. Chesnut says:

> The beautiful bright red berries of the Frijolillo or coral bean of southern and western Texas contain a powerful poisonous alkaloid. The plant is said to have poisoned stock in Texas nd in northern Mexico.

It contains *sophorin*, an amorphous alkaloid, which, according to Czapek, is probably identical with *cytisin.* The beans are somewhat used by the Indians o produce intoxication.

6. *Crotalaria* (Dill) L. Rattle-box

Herbs or occasionally somewhat woody plants, with simple or 3-7-foliolate eaves; yellow flowers borne in racemes; calyx 5-cleft, somewhat 2-lipped, tandard large, heartshaped; wings oblong or obovate; keel curved, stamens monadelphous, with anthers of 2 forms; pod inflated like the pea, but shorter and many-seeded. About 250 species found chiefly in the tropics.

Crotalaria sagittalis L. Rattle-box

Annual from 3 inches to a foot high, with a small straight root; stem branched, villous, terete or wing margined; leaves oval or oblong-lanceolate,

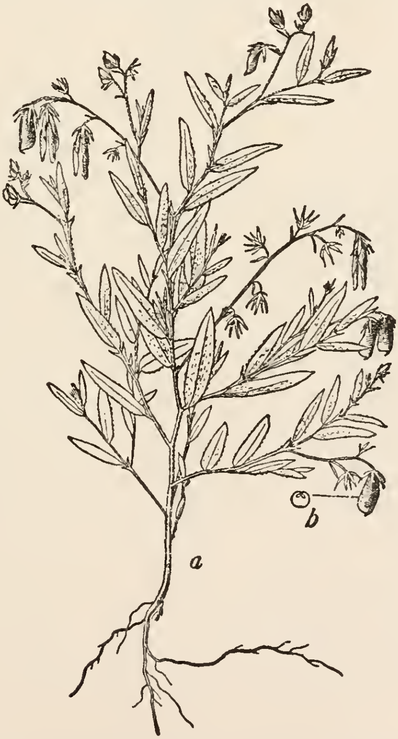


Fig. 300. Rattlebox (*Crotalaria sagittalis*). a, whole plant; b, cross section of seed pod—both one-third natural size. The cause of crotalism in horses. (U. S. Dept. Agr.)

from 1/2-1/3 of an inch wide, edge of the leaf entire or somewhat wavy and hairy; stipules united and decurrent on the stem, inversely arrow shaped; peduncles few-flowered; flowers yellow, about ¼ of an inch in diameter; calyx 5-cleft, standard of the flower large, heart-shaped; keel scythe-shaped; stamens monadelphous, anthers of 2 sizes, 5 smaller and roundish; pod large, inflated, bears a close resemblance to the garden pea, greenish at first, becoming blackish; seeds from 1/10-1/12 of an inch in diameter, flattish, kidney-shaped, which, when mature, break away from the point of attachment and rattle in the pod, hence the name "rattle-box."

Distribution. This plant is common in sandy soil from Maine to Minnesota, South Dakota, Iowa, Nebraska, and Northern Texas. The plant is extremely common on the sandbars of the Missouri river, where it may be collected by the wagon load.

Poisonous nature. The earliest mention of the poisonous nature of the weed was made by Drs. Stalker and Bessey. Dr. Stalker who performed some experiments with the plant gives the following symptoms:

> The disease had been known in this region for three or four years, but had not until the present summer (1884) prevailed to such an extent as to attract generally public attention. But now the loss in horse stock on some farms was not to be counted by hundreds, but by thousands of dollars. The disease proved to be one that had not hitherto come within the range of my experience, nor had I any information of anything exactly identical with it. I spent several days among the farmers on the Iowa side of the Missouri river, taking careful notes of the symptoms, and gathering the history of the progress of the disease. On some farms I found almost all the horses affected, and on others but a few individuals. Deaths were an almost daily occurrence, and the farmer who owned a large stock of horses did not know today whether he would have teams for his farm work a week later. The disease in most cases is very slow in its progress, but proving almost uniformly fatal after a number of weeks or months. There is a general decline of bodily vigor throughout this period, and the only abnormal symptom in many cases is that of marked emaciation and consequent weakness. Horses that have been kept at pasture through the summer, without work, and where the grass grew in greatest abundance, were so thin in flesh that they walked with the greatest difficulty. A critical examination of many of these patients revealed nothing more than the condition resulting from starvation. This was not uniformly the case. In a number of instances there was marked coma or stupor, the animal often falling asleep while eating. In some instances the animal would remain standing for a whole week, sleeping much of the time with head resting against some object. In a few instances the animal lost consciousness, and broke through fences and other obstructions. A number of the diseased animals were placed at my disposal, and assisted by Dr. Fairchild and Dr. Milnes, I made post mortem examinations of five subjects with the most perfect uniformity as to the lesions presented. In every instance there were marked haemorrhagic effusions into the fourth ventricle, the liver and spleen were abnormally dense, the walls of the intestines were almost destitute of blood, and the stomach enormously distended with undigested food. The stomach with its contents in some instances weighed as much as seventy pounds. These post mortem conditions, together with clinical symptoms, led me to believe the animals were obtaining some poisonous principle with their food. The symptoms in some cases bore such a resemblance to those produced by eating *Astragalus mollissimus*, or "loco plant" of the Western plains, as to direct my investigations to that family of plants. A careful examination of the meadow and pasture lands was not rewarded by the discovery of a single "loco plant."
>
> It took but little investigation, however, to find a closely related plant growing in great abundance, both in the meadows and pastures. This was the *Crotalaria sagittalis*, or rattle-box. This is also known as the wild pea, and is accounted by many farmers as the best of forage plants. Knowing the bad reputation of some of its near relatives, I determined to make some experimental tests with the plant. I employed a boy to collect about thirty pounds of the green plants, which I brought with me on my return to the college. I procured a strong young horse, affected with incurable catarrh, and attempted to induce him to eat the plant. This he persistently refused to do, though I sharpened

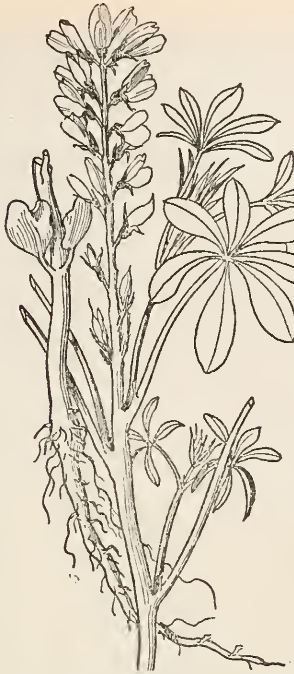


Fig. 300a. White Lupine (*Lupinus albus*). A forage plant introduced from the Mediterranean region. Seeds contain a bitter alkaloid. U. S. Dept. Agr.

his appetite by a protracted fast. It is a matter of common observation that animals eat it with the greatest relish in localities where it grows. Failing to induce the animal to take the plant voluntarily I prepared a strong infusion, and by means of the stomach pump gave the preparation obtained from about ten pounds of the plant. In twenty minutes stupor began to ensue, the eyes were closed, the head was rested against the side of the box, the breathing became stertorous, and all the symptoms developed that were to be seen in the patients previously examined. At the end of six hours the stupor began to disappear, the eye began to regain its brightness and in another hour the horse began to eat. The following day, when he had apparently recovered from its effects, he was given half the quantity of the drug as on the previous day. In this instance the symptoms were developed much more rapidly, the animal became unconscious in a short time and died in an hour and a half. The post mortem revealed the same condition of the brain as in the cases examined in the Western part of the State. I now resolved to make a second experiment, in which the animal should receive a small quantity for a number of days in succession. Having procured another subject for experimentation, and a bushel of mature fruit, or pods of the plant, I commenced on Sept. 5th, to give daily the infusion obtained from about one quart of the pods. On the fifth day of the experiment the characteristic stupor came on. The animal rested its head against the box and slept while standing. The symptoms grew more marked till the thirteenth day of the experiment, when the animal died. The post mortem showed the same as in the other cases. These experiments leave no doubt in my mind that the trouble along the Missouri river is occasioned by the animals' feeding on this little plant. It is from eight inches to a foot in height, with branching stems bearing yellow flowers in July and developing large pods resembling the pea, but containing a number of black, hard seeds. It grows on sandy bottom land, and is very abundant in the meadows and pastures in portions of the Missouri bottom. It is seldom seen among the tame meadow grass in any considerable amount. It thrives best among the wild grasses. Animals, doubtless, eat it much more than formerly, when the wild pasturage was better than at present. Cattle sometimes, though not often, suffer in the same way as horses.

The disease is also known as the Missouri Bottom disease. Hundreds of horses in the Missouri Bottom in Western Iowa and Eastern Nebraska die from eating this weed, it being most common in unbroken fields. Horses should be kept from all suspected fields. Only cultivated grasses and forage plants should be grown. Some doubt has been expressed that this plant is the cause of the trouble. The writer a number of years ago, in collaboration with Dr. Miller, investigated an outbreak near Council Bluffs. This disease occurred only in the bottoms, where the weed was common, and a large number of horses die from it annually. No other injurious plants could be found except some ergot on wild rye. A decoction of the weed found here was fed by Dr. McNeill to a horse but no injurious symptoms followed. A decoction of the seeds was fed to a guinea pig without any serious symptoms. Dr. F. B. Power however found a small amount of an alkaloid in the seeds which caused slight illness in a kitten. From all of these experiments we may conclude that rattle box is injurious under some conditions.

7. *Lupinus* (Tourn.) L. Lupine.

Herbs or rarely shrubs with generally palmately compound leaves; stipules adherent to the base of the petiole; flowers showy, in long, dense racemes; calyx deeply toothed and 2-lipped; corolla with an orbicular or ovate standard with margins reflexed; wings oblong, or obovate, lightly cohering, and enclosing the keel, which is incurved or beaked; stamens monadelphous, anthers of 2 forms; pistil with an incurved style and sessile ovary; pod flattened, somewhat constricted. About 100 species of temperate regions, or a few in warm regions. The North American species are chiefly west of the 100th meridian. The *Lupinus perennis* occurs in sandy soil from New England to Minnesota and Louisiana; *L. albus, L. luteus* and *L. angustifolia* are cultivated for forage in Europe, the seeds being used as a substitute for coffee.

Lupinus argenteus Pursh. Hairy Lupine

A much branched perennial, slightly shrubby, from 2-3 feet high, silky pubescent hairs appressed, leaves with small stipules; petioles equalling or longer than the leaves; leaflets sessile, narrowed at the base; flowers in rather dense, terminal racemes, purple; pod silky, pubescent, generally 3-5 seeded. A very variable species.

Distribution. Prairies of South Dakota to Western Nebraska to New Mexico, Utah, and from Arizona to Montana. Abundant in the foothills.

Lupinus perennis L. Wild Lupine

Perennial, somewhat hairy; erect stems, 1-2 feet high; leaves compound; 7-11 oblanceolate leaflets; flowers showy, purple-blue, in a long raceme; pods broad, very hairy, 5-6-seeded.

Distribution. Sandy soil from New England to Minnesota, Missouri, and the Gulf region.

Lupinus plattensis Watson. Nebraska Lupine

Somewhat like the preceding, with appressed silky-villous hairs, and a glaucous hue; leaflets spatulate; flowers in loose and short peduncled racemes; petals pale blue.

Lupine in flower (*Lupinus* sp.) On the western ranges. (Bull. Nev. Agr. Exp. Sta. 55).

Fig

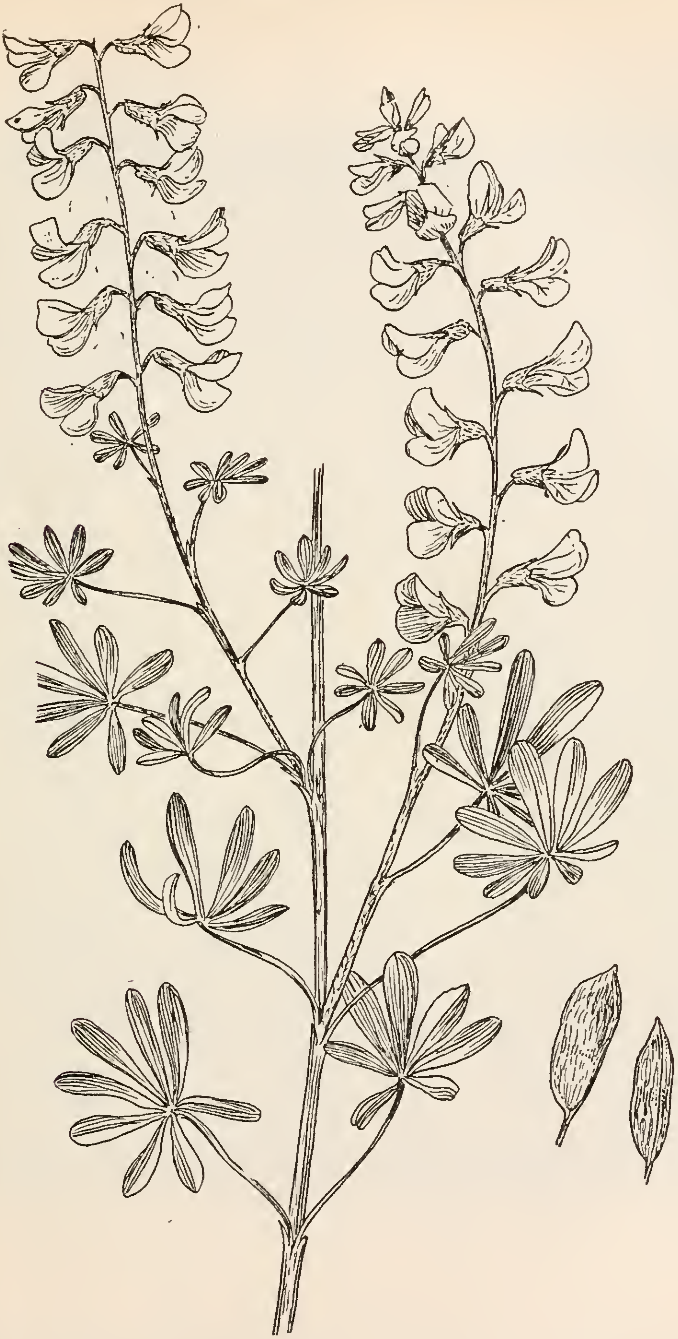


Fig. 301. Wild Lupine (*Lupinus Plattensis*). Causes lupinosus. Charlotte M. King

Lupinus leucophyllus Dougl.

Leafy, densely silky-tomentose perennial; compound leaves; 7-10 oblong-lanceolate leaflets; flowers in sessile racemes, densely flowered; petals blue or pink.

Distribution. Rocky Mountains, Colorado to Washington, and Northern California.

Lupinus holosericeus Nutt

A perennial, shrubby plant with silvery-canescent leaves; 12-20 inches high; compound leaves; 5-9 lanceolate leaflets; flowers in whorls or scattered; calyx bracteolate, the upper slightly 2-cleft; petals bright blue.

Distribution. Oregon to California.

Lupinus species. There are many other species of *Lupinus* in the Rocky Mountains and along the Pacific Coast. A great many of these have been looked upon with suspicion.

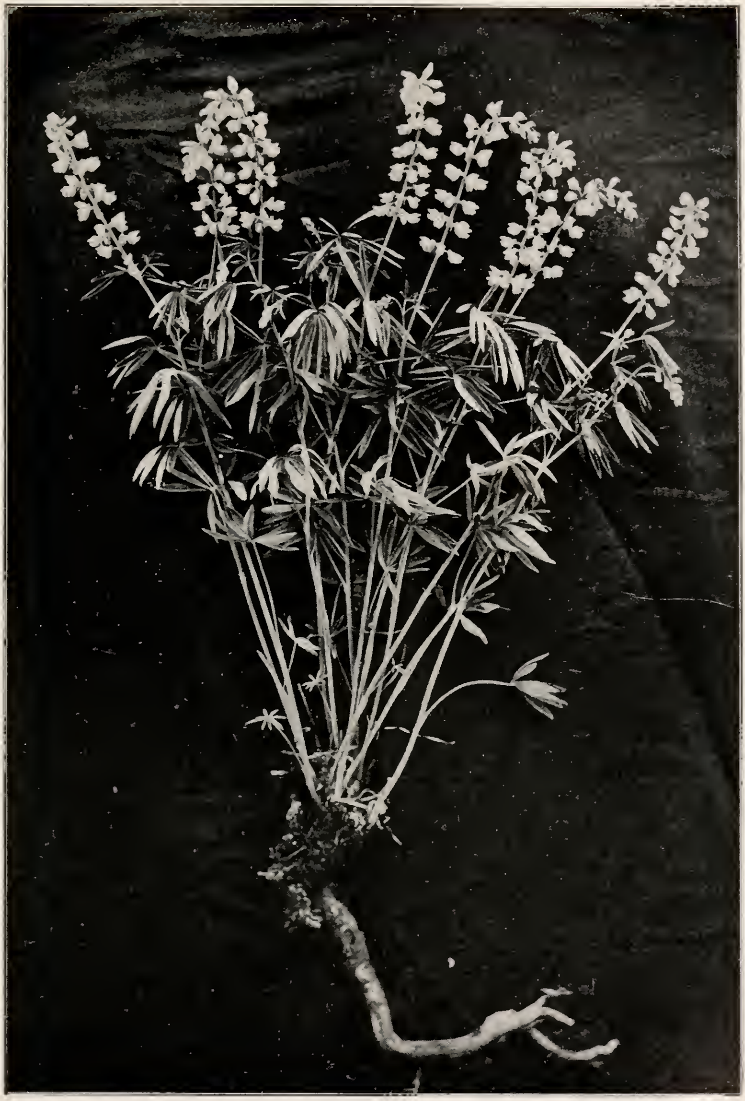
Poisonous properties. European white lupine, *Lupinus albus, L. luteus,* and others contain the glucoside *lupinin* $C_{29}H_{24}O_{16}$, a crystalline substance with a bitter taste and a fruity odor; *lupinidin* $C_8H_{15}N$, a pale yellow, heavy, oil with a pungent, bitter taste; *lupinin* $C_{10}H_{19}NO$, also bitter with an apple-like odor; *Lupinus angustifolius* contains *lupinin* $C_{15}H_{24}N_2O$, an intensely powerful alkaline substance. The substance *arginin* $C_6H_{14}N_4O_2$, found in the etiolated cotyledons of the lupine and the Soy bean, is a proteid. Prof. Chesnut says in regard to the *Lupinus leucophyllus* Dougl.:

> The above species is very abundant in Montana, where it is said to have caused the death of a very large number of sheep. There is some question whether the animals were killed by a poisonous constituent of the plant or merely by bloat. The seeds of all the lupines are probably deleterious in the raw state. In Europe, however, the seeds of *Lupinus albus*, after the bitter taste has been removed by steeping and boiling, are eaten by human beings as well as by cattle.

The so-called *ictrogen* obtained by European chemists from some of the lupines can be extracted by weakly alkaline water and is to be regarded as an active poisonous principle. Some European investigators, however, think that the alkaloids are not the cause of the poison. To the above poisonous species we may add *L. linifolius,* and *L. hirsutus.* The disease caused by these has long been known in Europe and has received the name of lupinosis. It is common where lupines are used for forage purposes. According to Friedberger and Fröhner from one-half to three-fourths of the animals perish. According to Arnold and Schneidermuhl the disease can be produced experimentally with *lupinotoxin* in sheep, horses, goats, and pigs. This substance occurs chiefly in seeds and pods. Dry heat does not destroy it but steam under pressure does. There is a probability that the poison is produced by metabolism.

Chesnut and Wilcox, in their paper on Stock-poisoning Plants of Montana, make the following statement in regard to the Lupine poisoning of Montana:

> So far as we have been able to observe, lupines are not very extensively eaten by sheep during the spring and summer. This statement is at least true for normal conditions where sheep are acquainted with the range and are not being trailed or driven. Horses and cattle take kindly to lupines and eat them in large quantities during their immature stages. When sheep are being trailed through strange country, or when they have just been unloaded from cars, and are in a hungry condition, they eat lupines ravenously in any stage of growth. The lupines are not considered valuable as forage plants for sheep until after early fall frosts, or until other forage plants have become dry and uninviting as



Great Basin Lupine (*Lupinus holosericeus*). Ripened pods of this are probably oisonous. (Bull. Nev. Agr. Exp. Sta. 62).

fodder. In late fall, and especially after early snowstorms, the lupines constitute one of the chief forage plants on some of the mountain ranges. It should be remembered that the leaves of lupines remain green and the plants offer slightly succulent forage after other plants have become dry.

The first case of poisoning from lupines which was brought to our attention occurred in August, 1896. A band of sheep, while being moved from one range to another was driven rapidly, and was constantly in a very hungry condition, when it was allowed to feed in a field of lupine for a short time. Within two hours after beginning to eat the lupine a number of sheep manifested violent symptoms of poisoning, and a few died within one hour after the appearance of the first signs of poisoning. Of the 200 sheep in the band 100 had died before the following morning. The season of 1896 was rather late and at the time when the poisoning occurred the lupine pods were fully formed, but the seeds were not quite ripe. In this case the sheep were driven away from the lupine as soon as the first symptoms of poisoning had been noticed and some of the sheep had eaten only small quantities of the plant. About 150 out of the 200 were affected, and as only 50 of these ultimately recovered it will be seen that the death rate was very high.

The owner of these sheep, during the same season cut a quantity of lupine hay during the second half of July. In the winter of 1897 a band of 150 bucks belonging to the same sheep raiser were kept in a covered corral and were fed on cultivated hay. On one afternoon during the winter these bucks were given a liberal quantity of the lupine hay. About three hours after feeding this hay a noisy disturbance was noticed among the sheep. Upon investigation the owner found the sheep in a frenzied condition, and during the night about 90 of them died. No more lupine hay was fed and no more trouble was experienced.

They state further that the lupine poisoning occurred in various parts of the state, in 1898 about 2,000 having been poisoned. 1,150 sheep died out of a single band of 2,500 sheep. They also state that one sheep raiser in Deerlodge Valley lost 700 sheep from the poisoning of lupine. They report another case which occurred on June 28, 1900, near Livingston, in two bands of sheep, each numbering 3,000, which were being trailed westward from Livingston. The sheep were liberally salted before being started on the trail; the first day they traveled about 5 miles, and camped on opposite sides of a small stream. After watering, one band was driven across the creek and camped on a bench about 30 feet higher than the stream. On the following morning, the sheep which had been driven across the stream manifested symptoms of poisoning; ultimately 1,900 died. This poisoning is referred to as lupinosis, a disease of which in Europe both acute and chronic forms are recognized, but in the United States the chronic form only has been recognized. The marked symptoms of poisoning are acute cerebral congestion, and great mental excitement. The sheep rush about in different directions, often running against the herder or other persons. The first stage of frenzy is followed by a second stage in which there is pronounced irregularity of movements and violent spasms, and falling fits. In many cases death occurs in from 1 to 1½ hours. The pulse during the attack is strong and regular. Lower animals are attacked by convulsions, and these convulsions resemble those caused by strychnine poisoning. The excretion of the kidneys is increased, and sometimes it is bloody. The post mortem conditions are described by Chesnut and Wilcox as follows:

Post mortem examinations of the sheep poisoned by lupines revealed conditions very similar to those found in the acute cases of loco disease, already described above, with the exception that in loco disease the kidneys were not affected. The lungs were slightly congested, but this condition was not so pronounced as in cases of larkspur poisoning. The cerebral membranes were in all cases congested. In the more violent cases small blood vessels had been ruptured in various parts of the body, which may have been due either to increase of blood pressure or to the struggles of the animal.

In regard to the treatment, Dr. Wilcox recommends as follows:

No remedies have been tried in cases of stock poisoning from American species of lupine. From our general experience with potassium permanganate it seems reasonable to suppose that this substance would probably destroy the lupine alkaloids in the stomach if administered promptly after the first signs of poisoning. In the main, however, reliance should be placed upon prevention. With regard to the use of lupine hay, our experience and observations indicate that this is always dangerous for sheep if cut at a time when the seeds are retained in the hay. Since the limit of the period during which lupines are not poisonous can not be determined for the present with any certainty, it seems advisable to abandon entirely the use of lupine hay for sheep, except after a preliminary test in feeding large quantities of the hay to one or two sheep. If it should prove to be non-poisonous, it may then, of course, be fed with safety.

The poisonous principle in all plants which have been fully investigated varies in quantity according to the stage of growth of the plant, and is located more abundantly in one part of the plant than in another. These facts seem to be strikingly true of lupine, since, as already indicated, the plants are sometimes eaten in large quantities with impunity, while at other times the plants cause extensive losses, especially among sheep. The evidence thus far collected regarding this matter indicates that the seeds are the most poisonous part of the plant.

Mr. O'Gara of Nebraska, in speaking of the Lupine says this:

There are three species of Lupines in the western part of the sand-hill region and throughout the foot-hills, which are worthy of attention. So far as can be learned, cattle and horses either do not eat them or are not harmed by them, but sheep men say that they are extremely poisonous to sheep when eaten after the pods have formed and have begun to ripen. Many sheep owners are very careful to avoid patches of Lupine in driving their sheep from one range to another, and never trust the flock to a green herder who is unacquainted with the range.

The three species common to the regions mentioned are the Nebraska Lupine (*Lupinus Plattensis* S. Wats.), the Silvery Lupine (*Lupinus argenteus* Pursh.), and the Low Lupine (*Lupinus pusillus* Pursh.). The last named is a small hairy plant four to eight inches high, much branched near the root, bearing commonly five leaflets at the end of the leaf-stalk. The densely clustered blue flowers are borne on a stalk four to eight inches long. The pod is finely-hairy and is three-fourths to one inch long.

Dr. Nelson conducted some experiments in poisoning from three species of Lupinus: *L. ornatus, L. sericeus, L. leucophyllus*; from which the following results were obtained with reference to the effect of feeding quantities of these plants. In regard to the first of these species, negative results were obtained in part; to sheep fed as early as May 30th, June 8th, July 14th, July 31st, and August 2nd, partly in the year 1898, and partly in 1901, these experiments being made in 1898 and 1901. In 1904 experiments were made with two sheep fed between November 16th, and December 22nd, receiving 274 pounds of this hay. This hay was eaten fairly well, and the sheep were given no other food except the lupine, and had constant access to water.

Some loss of flesh occurred in both sheep and one of them became affected, December 28th, with an attack of stomatitis with quite well developed ulcers in the mouth. He practically recovered by January 1st. No other untoward symptoms were manifested during the course of the experiment.

In regard to *Lupinus sericeus*, the results were in part negative, but June 28th, 1899, a sheep was fed 2 pounds of lupine that was in full bloom and partial fruit, gathered a few days previous. On the morning of the 29th, the sheep was drowsy, and kept a recumbent position. In the afternoon the comatose condition was more marked; he walked with an unsteady gait and pressed his head against the fence when he happened to reach it, showing a partial paralysis. The animal died on June 30th, slightly bloated.

The ventricles of the heart were partially and the auricles completely filled with a black coagulated blood. The lungs were congested, the stomach filled with partially digested food, otherwise apparently normal.

The experiments with *Lupinus leucophyllus* were negative.

8. *Cytisus* L.

Shrub with trifoliolate or unifoliolate leaves; showy flowers, chiefly in terminal racemes; calyx 2-lipped, with short teeth; standard ovate or orbicular; keels straight or curved; anthers large and small; ovary with many-ovuled, and incurved style; pod flat, oblong or linear. About 40 species, natives of Europe, Western Asia, and Northern Africa.

Cytisus scoparius (L.) Link. Broom

A stiff, nearly glabrous shrub; elongated, straight, angled branches; lower leaves 3-foliolate, obovate; leaflets which are mucronate-tipped; upper leaves sessile, often unifoliolate; flowers bright yellow, in elongated leafy racemes.

Distribution. Along the seacoast of Nova Scotia to Virginia, and very common along the Pacific Coast.

Poisonous properties. The Scotch Broom (*Cytisus scoparius*) common on the Pacific and Atlantic coast but naturalized from Europe, contains the alkaloid *cytisin* $C_{11}H_{14}N_2O$ and is poisonous. Blyth records 400 cases of poisoning from this. The symptoms in stock are slavering, vomiting, staggering, and general paralysis. *Cytisin,* occurring in many of the *Genisteae,* was found, in 1818, in *Laburnum anagyroides* and since then, has been found in many other species of the genus *Cytisus* and in *Ulex europaeus, Sophora sp., Thermopsis sp., Baptisia tinctoria, Anagyris foetida, Lotus suaveolens, Colutea cruenta,* and *Euchresta Horsfieldii.* Some species of the genera *Genista* and *Cytisus* do not contain *cytisin.* *Cytisus scoparius* also contains a volatile alkaloid *spartein* $C_{15}H_{26}N_2$, a single drop of which, according to Blyth, killed a rabbit that showed symptoms similar to those of nicotin poisoning.

9. *Melilotus* Tourn

Annual or biennial herbs with trifoliolate leaves; small white or yellow flowers in racemes with the odor of *cumarin*; teeth of the calyx short and nearly equal, shorter than the pod; corolla deciduous with obovate or oblong

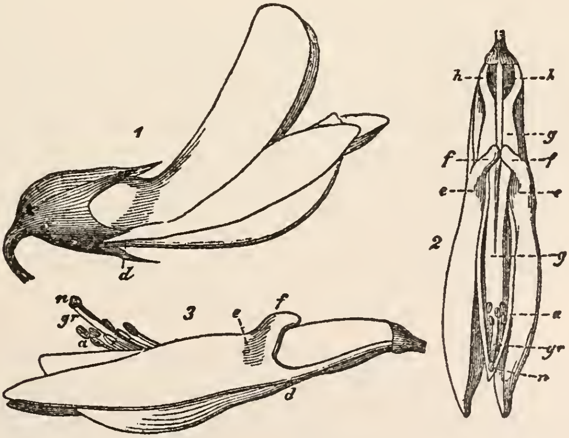


Fig. 302. Flowers of Sweet Clover (*Melilotus alba*). 1, Standard above. 2, Showing wings and keel. 3, Showing stamens and pistil in keel.

standard, obtuse keel, free from the stamen tube; stamens diadelphous; pod wrinkled, straight, ovoid or globose—1-2-seeded. A small genus of 20 species, native to Europe, Africa and Asia. 3 species naturalized, found in North America, 2 of them quite weedy.

Melilotus alba Der. Sweet Clover

An erect annual or biennial from 2-4 feet high; rather distant, compound leaves, leaflets obovate, oblong, obtuse, serrate, narrowed at the base, truncate, emarginate or rounded at the apex; flowers with white petals, small, fragrant; pod ovoid, reticulated and smooth.

Distribution. Abundant in waste places in the eastern and Atlantic states, also in the southern states and throughout the Mississippi valley, the Rocky Mountain region and the Pacific coast. Sweet clover is one of the most common weeds in pastures, and along roadsides.

Melilotus officinalis (L.) Lam. Wild Yellow Sweet Clover

An upright, yellow flowered herb from 1-4 feet high; leaflets oblong, or oval, the apex more or less obtuse; corolla yellow; pod with irregularly reticulated veins.

Distribution. Common in waste places in the irrigated districts of the west, becoming more or less common in the Mississippi Valley and along the Atlantic Coast.

Melilotus indica (L.) All. Sweet Clover

An upright annual like the preceding, but with much smaller yellow flowers.

Distribution. Native to Europe, introduced in ballast along the Atlantic coast and abundant on the Pacific coast.

Poisonous properties. The sweet clovers contain the substance *cumarin* $C_9H_6O_2$, which is found in the Tonka bean, sweet vernal grass, vanilla grass, etc. In Europe the sweet clover is suspected of being poisonous. This plant is used as a forage plant in the South, and Mr. Cohagen of Iowa, has had excellent results in feeding this plant to stock. Its protein content is equal to that of alfalfa. It is probable that some forms are entirely inert. Some years ago, the writer conducted an experiment in feeding considerable quantities of sweet clover, but without any injurious symptoms resulting. A tincture prepared by mixing the fresh flowers with alcohol has a vanilla-like odor, and a bitter taste. Dr. Millspaugh states that in large doses, *cumarin* causes nausea, vomiting, vertigo, great depression of the heart's action, and cold extremities. Dr. Schaffner states that both of the sweet clovers are objectionable in wheat, because of the foul odor the seed imparts to the flowers. According to Friedberger and Fröhner sweet clover causes paralysis of the muscles. Dr. MacOwen states that in New South Wales, the *M. indica* is said to cause paralysis of horses.

10.. *Medicago* L. Medick, Alfalfa

Herbs with pinnately 3-foliolate leaves; leaflets dentate toothed; flowers small, yellow or violet in axillary racemes or heads; calyx teeth short nearly equal; standard obovate or oblong; stamens diadelphous; ovary 1-ovuled; pod curved or spirally twisted, indehiscent 1-few seeded. About 50 species native to Europe and Asia. Bur clover (*Medicago hispida*) and hop clover or black medick (*M. lupulina*) are used as forage plants on the Pacific coast but eastward are regarded as troublesome weeds, the former injurious to wool.

Medicago sativa L. Alfalfa

An upright, smooth perennial; leaflets obovate, oblong, toothed, obtuse emaginate or mucronate; stipules entire; flowers in a short raceme violet; pod spirally twisted. A valuable forage plant.

Distribution. Common in the irrigated districts of the West, also frequent eastward, but common southward; spontaneous from New England to Minnesota, Kansas, northward and westward; native to Europe and Asia.

Poisonous properties. A large amount of the green fodder is said to produce tympanites, but alfalfa is, however, one of the best of forage plants.

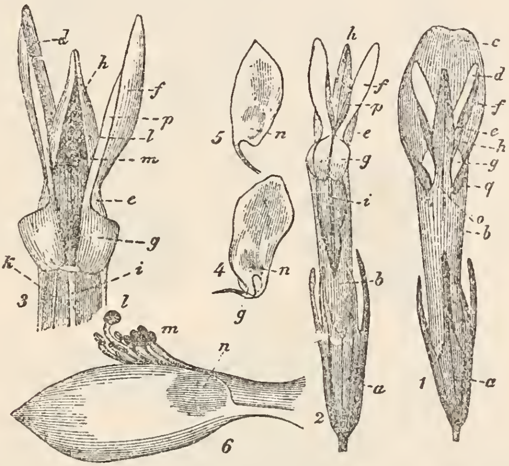


Fig. 303. Flowers of Red Clover. 1, a, Calyx. c, Standard. 2, f, Wings, h, keel, 4, 5, Wings, 6, keel.

11. *Trifolium* (Tourn.) L. Clover

Herbs; leaves mostly 3-foliolate, palmately or pinnately; stipules united with the petioles; leaflets usually toothed; flowers in dense heads or spikes; calyx persistent; lobes 5, nearly equal, corolla withering or persistent, claws alternate to the stamen tube; stamens diadelphous or the tenth one separated for a part of its length; pods small and membranous, indehiscent or dehiscent, 1-6 seeded.

A large genus of about 250 species mostly in the northern hemisphere. Many are valuable forage plants, among these are red clover (*T. pratense*), alsike clover (*T. hybridum*) and white clover (*T. repens*). Several are weedy as yellow hop clover (*T. agrarium*), low hop clover (*T. procumbens*), and stone clover (*T. arvense*).

The alsike clover (*T. hybridum*) and red clover (*T. pratense*) occasionally produce bloat.

Dr. Jacob Moses and A. M. Harcourt have recently described a disease sometimes caused by alsike clover.[1]

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[1] Bull. Tenn. Agr. Exp. St. 18:28 (1905).

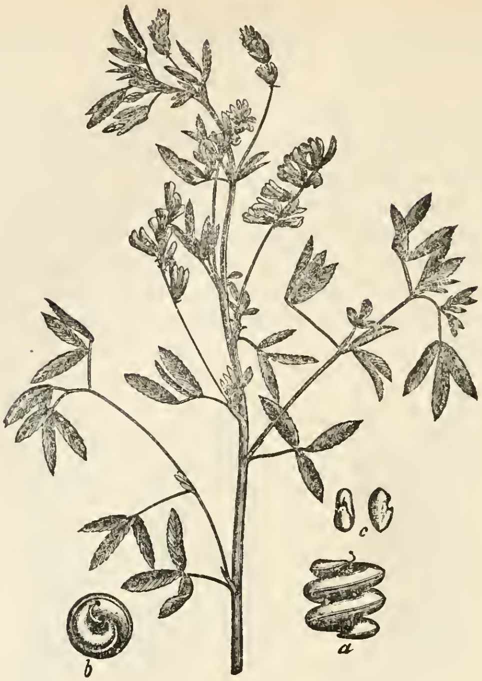

Fig. 304. Alfalfa (*Medicago sativa*). a, b, seed pod; c, seed. An excellent forage plant, sometimes causes bloat. (U. S. Dept. Agr.)

"The cause of this trouble among horses and mules is not positively understood. Whether the toxic effect is due to the plant itself, which possibly undergoes some change within the digestive tract and subsequently liberates a poison, or whether it is due to the presence of a mould in connection with alsike clover, is still undetermined. The mould has been strongly suspected. To determine this point will require further investigation. It is known, however, that the principle lesions are produced on the skin and mucous membranes.

"The symptoms of this disease vary to some extent, depending upon the location of the lesions and the length of time the animal remains on the alsike pasture after the symptoms begin to develop. The cases which came under observation in Marshall County showed marked similarity of symptoms, involving principally the skin, the mucous membranes of the mouth, and the eyes.

"The prevailing symptoms of the disease are as follows:

On the skin are inflamed areas, appearing at first as more or less rounded vesicular swellings, varying from one-half inch to five or six inches, or more, in diameter. The hair over the affected areas stands erect, and has a dull appearance, indicating loss of vitality. Later the skin becomes hard and puffed out, as the result of the formation of pus underneath. Finally, the deadened skin is cast off, leaving a deep, raw, angry-looking ulcer, which eventually heals, with the formation of a conspicuous scar, covered with more or less white hair. These changes in the skin may occur on any part of the animal, but especially on the limbs, body and croup. The eye symptoms consist of a marked conjunctivitis, with swelling of the eyelids, sensitiveness to light, and a watery discharge from one or both eyes. The mucous membranes of the mouth become inflamed (stomatitis), ulcers form, and the animal slobbers and refuses to eat. The advanced cases are frequently accompanied by emaciation. The tongue is usually affected, and the inflammation may extend throughout the entire digestive tract. The functions of the liver may be disturbed, and a yellowish (jaundice) coloration of the tissues follows. In such cases symptoms of colic are not uncommon, and the respiratory tract may become involved and pneumonia develop. Some observers in other countries have noticed marked nervous symptoms, such as excitement, convulsive movements, staggering gait, and paralysis of the throat, with inability to swallow, the paralysis at times becoming generalized, the animal getting down and being unable to rise. In the cases observed in this state, the nervous symptoms, except the general depression, were not very noticeable.

"The outcome of the disease depends upon the location and extent of the lesions upon the horse or mule affected. If they are situated on the exterior the animal will readily recover as soon as removed from the alsike pasture. If the vital organs are involved, such as the brain, lungs and liver, the disease may readily produce death. Among those cases occuring in this State, not a single fatality has been heard of at the Station. But even though the death rate is small where the ordinary precautions are taken, the disease

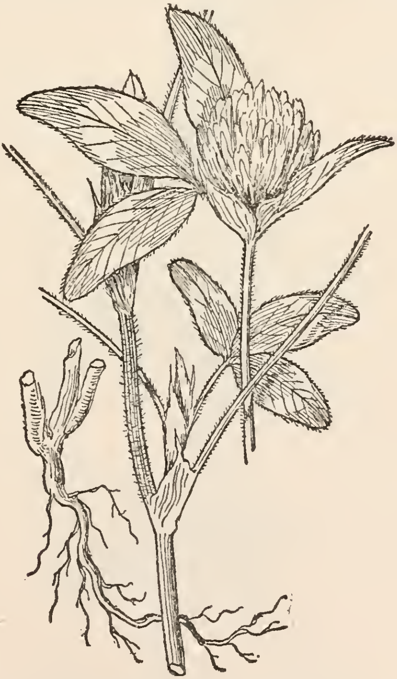

Fig. 305. Red Clover (*Trifolium pratense*). Occasionally the cause of bloat. (U. S. Dept. Agr.)

has considerable economic importance, since it leaves the animal more or less disfigured by the formation of scars, which materially depreciate his market value.

"The treatment is comparatively simple. As soon as the disease is recognized the animal should be removed from the alsike clover pasture and the wounds subjected to ordinary antiseptic treatment, such as frequent washing with 5 per cent solutions of carbolic acid or creolin, and the application to the ulcers on the skin of drying powders, consisting of boric and tannic acids in equal amounts."

The so-called clover sickness is supposed to be caused by the clover rust which has been described elsewhere. No doubt some of the trouble arising from feeding clover hay is caused by moulds found on the hay. Dr. W. D. Gilchrist says that he has observed several cases of the kind in this state. The animals showed extreme restlessness followed by coma, bloody discharge from faeces followed by diarrhoea, weakness and debility. Change in fodder caused the trouble to cease.

I have recently received a similar complaint from Dr. C. J. Scott of Knoxville, Iowa, three animals having succumbed.

Trifolium incarnatum L. Crimson Clover

A soft pubescent, slightly branched, annual; leaves long petioled;broad stipules; leaflets nearly sessile, obovate or obcordate cuneate at the base,

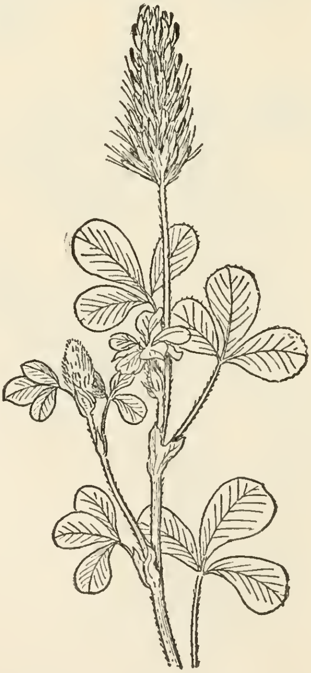

Fig. 306. Crimson Clover (*Trifolium incarnatum*). Sometimes produces phytobezoars, which may cause death. (U. S. Dept. Agr.)

denticulate; flowers in elongated, oblong or ovoid, heads, sessile; calyx hairy, lobes plumose pointed, corolla crimson.

Distribution. Used as a cover crop and a forage plant in the south and east. Found on ballast from Maine to Pennsylvania. Native to Europe.

Injurious properties. According to Prof. Coville it produces phytobezoars and ocasionally causes death in animals.

Trifolium repens L. White Clover

A smooth perennial with slender creeping and spreading stems; leaflets inversely heart-shaped or notched, obscurely toothed; stipules narrow; peduncles very long, flowers in small loose heads reflexed when old; calyx shorter than the white corolla; pods 4-seeded.

Distribution. In fields and waste places throughout eastern North America, the Northwest and the Rocky Mountains.

Poisonous properties. Said to cause tympanites in cattle and slobbering in horses.

Psoralea L. Psoralea

Perennial herbs, usually sprinkled with glandular dots; leaves generally 3-5 foliolate; flowers spiked or racemed, white or mostly bluish-purple; calyx 5-cleft, persistent; stamens diadelphous or occasionally monadelphous; pods about as long as the calyx, 1-seeded.

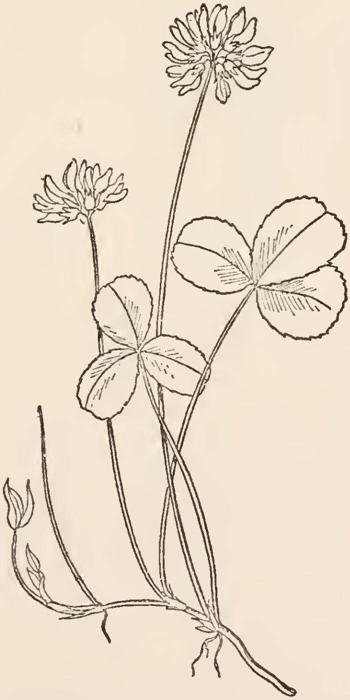

Fig. 307. White Clover (*Trifolium repens*). Occasionally the cause of tympanites in cattle. (Lamson-Scribner, U. S. Dept. Agr.)

About 100 species of wide distribution, many native to the plains, the roots of some being tuberous and farinaceous. The Indians used the tuberous roots of the *P. esculenta,* known as Pomme Blanche, or Pomme de Prairie, of the voyageurs for food. The roots of *P. hypogaea* and *P. cuspidata* were also used.

Psoralea argophylla Pursh. Silver-leaf Psoralea

Densely silvery, pubescent with appressed hairs; stem zig-zag, divergently branching, from 1-3 feet high; leaflets elliptical-lanceolate; flowers spicate, interrupted, blue; pod oval, membranaceous, plant seldom seeding.

Distribution. From Wisconsin to Kansas and New Mexico to the Northwest territory.

Poisonous properties. This plant was suspected of being the cause of a severe case of poisoning in Story County, Ia., two years ago. This is the first time the writer has known plants of this genus to cause poisoning, but he has had some correspondence with the parties concerned and thinks there can be no doubt that the poisoning was caused by the plant in question. A child was seriously poisoned by eating the seeds of this plant, but she finally recovered. It was thought this poisoning might have been caused by *Astragalus caryocarpus* but the plant sent me was the above.

13. *Tephrosia* Pers. Hoary Pea

Herbs or somewhat shrubby plants; odd-pinnate compound leaves; flowers in racemes or short clusters, red or white; stipules small; calyx 5-cleft; petals 5; standard roundish, usually silky outside, turned back, about as long as the coherent wings and keel. About 120 species, native of warm and tropical regions, a few are found in the United States.

Tephrosia virginiana Pers. Goat's Rue. Catgut

Perennial with villous or silky and whitish hairs; stem erect and simple, 1-2 feet high; leaflets 17-25, linear-oblong; terminal oblanceolate, narrowed to cuneate at the base; emarginate at the apex; flowers yellowish purple in long, dense racemes.

Distribution. In dry and sandy soil from Maine to Louisiana, west to Minnesota and Eastern Iowa, to Mexico.

Poisonous properties. This species, along with others, was formerly used to poison fish. The Mexican species, *T. toxicaria,* gets its name from its supposed toxic properties, and in South America, one species is commonly employed by the natives to poison the fishing streams.

The root is also poisonous to frogs and guinea pigs.

Tephrosia toxicaria contains the glucoside *tephrosin.* Several active substances have been obtained by Hanriot * from one species, *Tephrosia Vogelii.* Three substances were isolated; one, *tephrosal* $C_{10}H_{16}O$ is toxic especially to fish; a second toxic substance is *tephrosin* $C_{31}H_{26}O_{10}$.

14. *Robinia* L. Locust Tree

Trees or shrubs; stipules often prickly or spiny; leaves compound, odd-pinnate; the oblong leaflets with short stipules; flowers showy in axillary race-

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* Compt. Rend. 1907; 498-651. Journal Chemical Society Abs. 92:386, 1907.

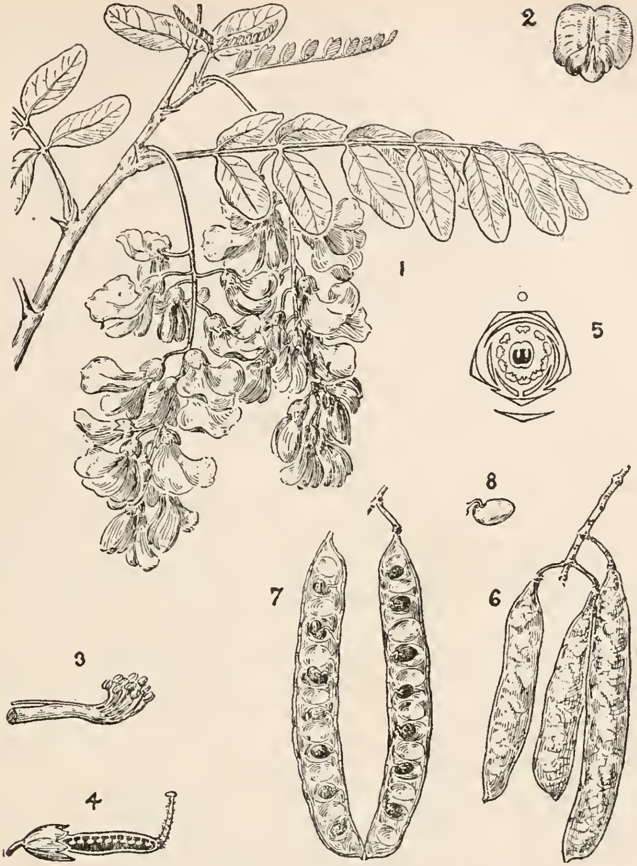

Fig. 308. Black Locust (*Robinia Pseud-acacia*). 1. Flowering branch. 2. Flower. 3. Tube of stamens. 4. Longitudinal section of pistil. 5. Diagram of flower. 6. Legumes. 7. Pod open, showing seed. 8. Seed. 1, 2, 6, 7, 8, one-half natural size. (M. M. Cheney in Green's Forestry of Minnesota.)

mes; calyx short, 5-toothed, and slightly 2-lobed; standard large, about as long as the wings and equal; stamens diadelphous; pod flat, several seeded and margined. A small genus of 6 species, native of North America and Mexico. Several species are cultivated for ornamental purposes, like the *Robinia viscosa,* which is native from Virginia to North Carolina and Georgia, and the *Robinia hispidia,* native to the mountains of Virginia and Georgia. The *R. neo-mexicana,* with purple flowers, native to S. Colorado and New Mexico, is frequently cultivated.

Robinia Pseudo-acacia L. Locust Tree, False Acacia or Black Locust

A large tree with rough bark, spiny stipules; 9-19 stalked leaflets, obtuse, emarginate, or mucronate; flowers in loose drooping racemes, white, fragrant; pods smooth; standard yellowish at the base.

Distribution. Widely planted as an ornamental tree. It produces valuable timber which is extensively used for posts. This species is, however, badly infested with the borer.

Robinia viscosa Vent. Clammy Locust

A small tree with rough bark; stipules short, occasionally spiny; twigs and petioles glandular; leaves 11-25, stalked; leaflets obtuse and mucronate; nearly smooth; racemes dense; flowers in rather dense racemes, pinkish, not fragrant; pedicels glandular, hispid; pod hispid.

Distribution. Southwestern Virginia to Georgia, occasionally escaped from cultivation northward.

Poisonous properties. The bark and leaves of this species contain a powerful poison which has proved fatal to persons eating them. Children have been poisoned by eating the roots. It is true, however, that the flowers of the plant are often eaten with impunity and that bees collect from them large quantities of nectar. Dr. Rusby states that the occasional poisonous properties of honey are due to its origin in these flowers, though there are gool theoretical reasons for doubting this. The bark of young twigs is sometimes pounded to a pulp, and used to make a tincture which is used in medicine as a tonic and cathartic, while the medicinal use of the flowers is mildly narcotic. It contains the substance *robinin* $C_{33}H_{40}O_{19}$ an aromatic glucoside which resembles the glucoside *quercetrin,* and is found chiefly in flowers, also the substance *obigenin* $C_{15}H_{10}O_6 + H_2O$. The seeds are also poisonous, and Dr. Millspaugh quotes Dr. Shaw as follows, in regard to the symptoms produced by poisoning from eating the seeds: "Inability to hold the head upright, nausea and attempts to vomit, with a tendency to syncope, when in an upright position; voice, respiration and heart's action feeble, as from exhaustion, a painful paralytic condition of the extremities, which become shrunken on the fifth day. All the symptoms seemed like those produced by a long-continued diarrhoea, though in this case purging was not present." Dr. Johnson states that the symptoms of poisoning are those of Belladonna poisoning, a fact also noted by Dr. Waldron in the case of a horse that had eaten the bark; Friedberger and Fröhner state that the animals have colic, tympanites and paralysis.

Dr. Rusby comments upon the poisonous character of the common black locust as follows:

> Of this Dr. Johnson records that by eating the roots children are poisoned with symptoms like those of Belladonna poisoning, and that the bark and leaves are emetic. Prof. F. W. Power has experimented upon himself with the stem bark of this tree, proving the very serious effects which it produces, and he has examined its composition with the result of showing that the poisonous constituent is an albuminous substance, thus confirming the general character of that family, the *Leguminosae.* The most positive and prominent case recorded in regard to this article is that of Dr. Z. P. Emery. In the latter part of March, 1887, thirty-two boys, inmates of the Brooklyn Orphan Asylum, were poisoned at one time by eating a bark which was being stripped in the vicinity for the making of fence posts. None of the cases terminated fatally. The prominent symptoms, stated in the order of their occurrence, were the vomiting of a ropy mucous, flushing of the face, dilated pupil, dryness of the throat, feeble pulse, extremities cool, face pale, vomiting of blood, cold extremities, heart feeble and intermittent, face deathly pale and stupor. The symptoms as I have named them are seen to be progressive. A rash similar to that of Belladonna poisoning was also present, but very fleeting. In the beginning there was a high fever. Treatment consisted of sinapisms over the stomach, subcarbonate of bismuth, camphor and brandy.

A farmer in Dallas County, this state, informs me that sometimes the leaves are macerated in water and used to kill flies.

A case of poisoning to a horse was recorded in *Breeders' Gazette* in 1909. In this case the horse had eaten some of the bark of a tree. The symptoms were similar to those recorded by Dr. Waldron.

15. *Sesbania.* Scop. Sesban

Tall, smooth, branching herbs or shrubs with pinnate leaves and yellow flowers in axillary or compound racemes; calyx bell-shaped, obliquely truncate, 5-toothed; standard short, orbicular; wings oblong; keel blunt; stamens diadelphous; style short, incurved at the apex; legume oblong, stalked, compressed, the endocarp membranaceous, at length separating from the coriaceous epicarp and enclosing 2 seeds. A small genus of 15 species of warm or temperate regions.

Sesbania platycarpa Pers.

A tall, smooth, branching annual vine; leaflets 10-35 pairs, mucronate, pale beneath; racemes shorter than the leaves; corolla yellowish purple spotted, with membranaceous sacked pods.

Distribution. From the Carolinas to Florida, Missouri, and Texas.

Poisonous nature. In 1897, Dr. A. P. Anderson sent this to the writer with a letter from some stockmen from South Carolina, who stated that it was suspected of poisoning his cattle. Mr. Chesnut records a similar statement as follows:

> In 1897, the United States Department of Agriculture received from South Carolina the seeds of this plant, which were found in the stomachs of cows.

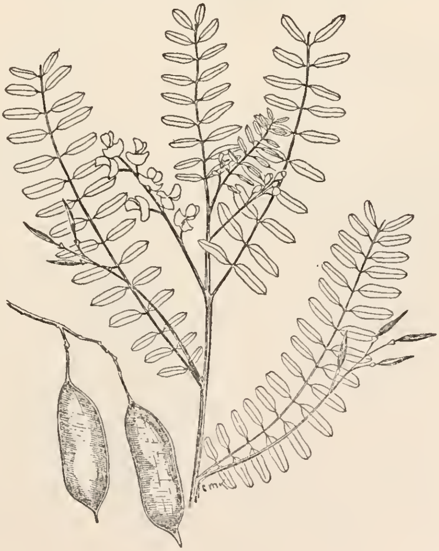

Fig. 309. Sesban (*Sesbania platycarpa*). This plant is common in the southern states; found along roadsides and woods; known to be poisonous. (Charlotte M. King.)

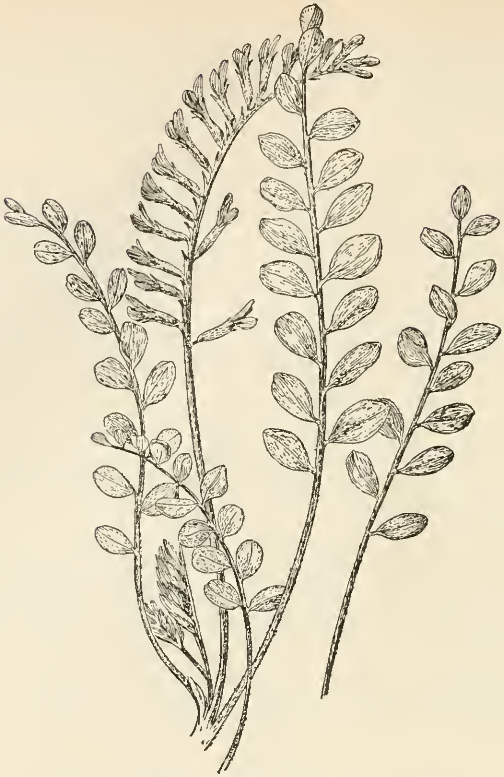

Fig. 310. Loco Weed (*Astragalus mollissimus*). Charlotte M. King

16. *Astragalus* L. Milk Vetch

Chiefly perennial herbs with odd pinnate or occasionally simple leaves, with stipules; flowers spicate or racemose; calyx 5-toothed, tubular; corolla clawed, usually long and narrow; standard erect, wings oblong; keel nearly as long as the wings; stamens diadelphous; pod several to many-seeded, dehiscent or indehiscent; 1-2 celled. A large genus of about 1000 species of wide distribution in the United States, largely western. Several species are used in medicine. One plant is widely known as the loco weed. One species native to gravelly knolls or dry places of the Mississippi Valley is known as the ground plum or hog pea (*A. caryocarpus*). This species is said to be edible. It should, however, be used with caution.

Astragalus mollissimus Torr. Loco Weed

A stout, short-stemmed perennial with membraneous stipules; leaflets 19-27, ovate oblong; flowers in dense spikes, violet purple, rather large; pod oblong, glabrous somewhat compressed, sessile, furrowed at both sutures, at length curved.

Distribution. Found on plains of Nebraska, Kansas, Colorado to Texas and New Mexico.

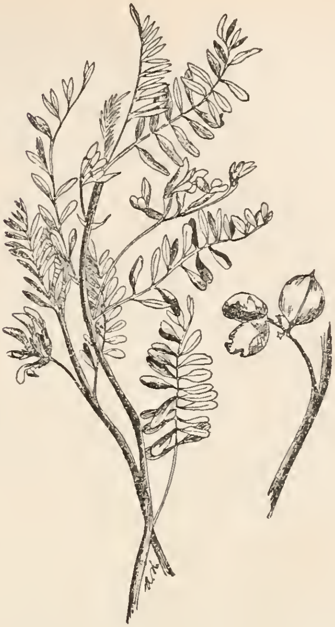

Fig. 311. Ground Plum (*Astragalus caryocarpus*). It is not known whether this species is poisonous or not, although some of the related species are known to be poisonous and belong to the loco weeds. It is said that the pods of this species are edible. (Ada Hayden.)

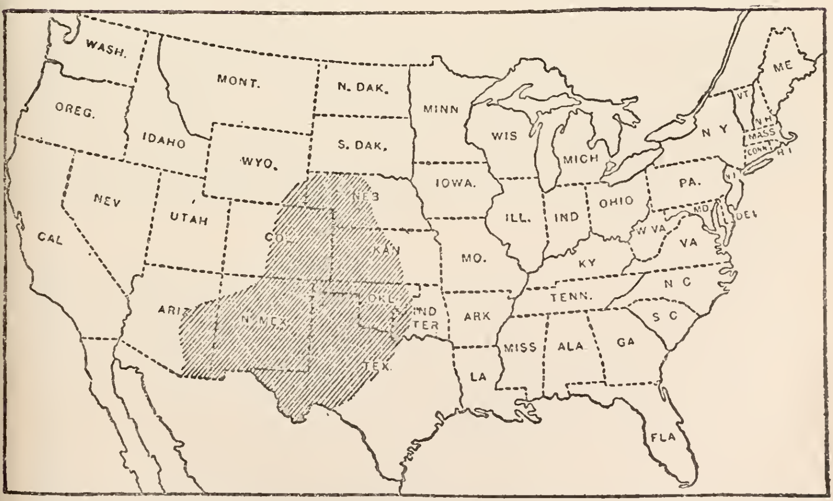

Fig. 311a. Map showing distribution of Loco Weed or Purple Loco Weed (*Astragalus mollissimus*). After Marsh, U. S. Dept. Agr.

The term loco weed is applied to a great many plants. In addition to the species mentioned above *A. oocarpus, A. Crotalaria* and *A. lentiginosus* must be added; species of *Oxytropis* are considered in another connection. The *Sophora sericca* of this family, *Malvastrum coccineum* of the Mallow family and corydalis (*Corydalis aurea* var. *occidentale*) have at times been classed as loco weeds. Thus far none of these plants except those belonging to the pulse family have been found to cause loco poisoning.

Astragalus Bigelovii Gray. Rattle-box

A subacaulescent, soft, silky, villous perennial; long, scape-like peduncles; flowers in dense spikes; violet pod oval-oblong, densely woolly, sulcate.

Distribution. From S. W. Colorado to Texas and Mexico.

Astragalus Pattersoni A. Gray

Perennial, robust, 1-2 feet high, with appressed-pubescence, or sometimes smooth; leaflets oblong, rather thick; peduncles racemosely many-flowered; corolla white, the keel sometimes purplish at the tip; pods smooth, sessile or stipitate; abruptly contracted within the calyx.

Distribution. Southwestern Colorado to Utah.

Astragalus Hornii A. Gray

A glabrous or minutely pubescent perennial; slender stems; leaflets about 21, narrowly oblong; peduncles longer than the leaves; flowers in a dense head, or short spike, numerous, small; calyx teeth subulate; pods ovate, from a broad base, straight, villous pubescent.

Distribution. From Southern Utah to California.

Poisonous properties. It is regarded as a very troublesome weed. Colorado has passed a law for its extermination, the state having paid out nearly $200,000 in bounties between 1881 and 1885 to check its ravages. Much has been written on the subject of the poisonous properties of the woolly loco weed and other members of the genus. Brewer and Watson, in their Botany of California, state that the last species described is said to be poisonous to sheep, and Prof. Chesnut states that stock are affected by this loco weed in the southern part of California. It has certainly been regarded as a poisonous plant for a long time, and numerous investigations have been carried on in regard to its poisonous properties by Dr. Stalker, Prof. Sayre and others; Dr. Stalker coming to the conclusion that the loco poisoning might be brought about through the action of intestinal worms.

Prof. Sayre reported the death of a jack rabbit with symptoms similar to those recorded for horses and cattle. He was, however, unable to find a poisonous principle. Miss C. M. Watson reported a small amount of an alkaloid from the stemless loco weed, *Oxytropis Lamberti.* Dr. Mary Gage Day in Dr. Vaughn's laboratory found that when a half grown kitten was fed with milk containing a decoction of the root, stem and leaf, emaciation, convulsive excitement, and, finally death occurred; when an adult cat received 60-70 cc. of a more concentrated solution death ocurred on the thirteenth day and subcutaneous injection of a concentrated decoction in frogs and chickens caused death in 1-2 hours from heart paralysis. Dr. J. Ott experimented with *Astragalus mollissimus* and found that it decreased irritability of the motor nerves affected the sensory ganglia of the nervous system, preventing them from readily receiving impressions and killed by arresting the heart action.

Dr. B. T. Galloway states that the loss from "loco" poisoning in Colorado alone has reached the sum of one million dollars per annum. It might be said in this connection that Prof. Power and Mr. Gambier investigated the subject, but were unable to locate definitely the kind of alkaloid. These gentlemen state:

> One kilogramme of the Astragalus herb gave 0.2 of a gramme of the alkaloid, equivalent to 0.006 per cent. Nothing further was determined concerning its nature, as it does not appear to be especially active. An extract from one kilogramme of the seed of the Crotalaria gave 1.1 grammes of an alkaloid, 0.036 per cent of the weight of the seed. It had a bitter taste, and seems to be more potent than that obtained from Astragalus.

From these investigations these authors conclude that both the Astragalus and the Crotalaria contain very small amounts of toxic alkaloids, to which the symptoms of poisoning may be reasonably attributed. Prof. Sayre, who has not gone into the details in the paper referred to, however, reiterates what he has stated in several previous ones, that it is a question whether so small amount of alkaloid could produce such grave physiological disturbances.

The symptoms of poisoning are very well given in a paper by Prof. Chesnut:

> Horses, cattle, and sheep are affected by loco, but the principal damage is done to horses. The effect is not acute, but in its slow progress stimulates diseases caused by bacteria, worms, or other parasites or such as are caused in man by the continued use of alcohol, tobacco, or morphine. Two stages are recognized. The first, which may last several months, is a period of hallucination or mania accompanied by defective eyesight, during which the animal may perform all sorts of antics. After acquiring a taste for the plant it refuses every other kind of food, and the second stage is ushered in. This is a lingering period of emaciation, characterized by sunken eyeballs, lusterless hair, and feeble movements. The animal dies as if from starvation, in periods ranging from a few months to one or two years.

Dr. Carl Ruedi isolated an acid (*loco acid*) from it to which he attributed the poisonous qualities of the plant.

Astragalus is said to cause considerable trouble in Nebraska. "In regard to the treatment," says Mr. O'Gara,

> There is little to be said. All medicines that have been tried seem to have been of doubtful effect. More can be done by keeping animals away from loco than in any other way. As long as there is a plentiful supply of grass, there is little to be feared, but when pastures and ranges run low, stock should be closely watched. At the very first appearance of trouble, affected animals should be removed to some place where they cannot gain access to loco. Good nourishing food should be given. If the disease has obtained a strong hold on the animal there is little hope of recovery under the best of treatment, hence the need of early treatment and prompt removal from the source of the trouble.

Dr. Mayo suggests the following treatment:

	OUNCES
"Sulphate of iron, pulverized	1
Gentian root, pulverized	4
Ammonium chloride, pulverized	1
Potassium nitrate, pulverized	1

Mix thoroughly and give from a heaping teaspoonful to a tablespoonful, according to the size of the animal, in the food three times daily."

Dr. Dwight C. Marsh and Albert C. Crawford under the direction of Dr. R. H. True who has charge of the Poisonous Plant Investigation of the U. S. Department of Agriculture, have arrived at conclusions wholly at variance with previous investigation. They conclude that *Oxytropis Lamberti* poisons horses, sheep, and cattle and that *Astragalus mollissimus* poisons horses, but does not poison cattle because they rarely eat it. Dr. Marsh states that the symptoms described by stockmen were corroborated; these are:

> The lowered head, rough coat, slow, staggering gait, movements showing lack of muscular coördination, sometimes more or less paralytic symptoms, a generally diseased nervous system, and in the later stages of the disease extreme emaciation.
>
> The principal pathological changes are pronounced anemia of the whole system, diseased stomach walls, and in acute cases a congested condition of the walls of the stomach; while in chronic cases there are frequently ulcers. Generally speaking, locoed cattle have ulcers in the fourth stomach. There is an excess of fluids in the various cavities of the body. This is especially noticeable in the epidural space of the spinal canal. Here the effusion is more or less organized, presenting the appearance of a gelatinous mass, which is especially abundant in the lumbar region and about the exits of the spinal nerves. In most locoed females the ovaries are found in a diseased condition.

Dr. Crawford from his laboratory work concludes:

> The symptoms described in stock on the range can be reproduced in rabbits by feeding extracts of certain loco plants. Those especially referred to here under the term "loco plants" are *Astragalus mollissimus and Astragalus Lamberti* (*Oxytropus Lamberti*).
>
> The production of chronic symptoms in rabbits is a crucial test of the pharmacological activity of these plants.
>
> It is the inorganic constituents, especially barium, which are responsible for this poisonous action, at least in the plants collected at Hugo, Colo.; but, perhaps, in the future, loco plants from other portions of the country may be found to have other poisonous principles.
>
> There is a close analogy between the clinical symptoms and pathological findings in barium poisoning and those resulting from feeding extracts of certain of these plants. Small doses of barium salts may be administered to rabbits without apparent effect, but suddenly acute symptoms set in analogous to those reported on the ranges.
>
> The administration of sulphates, especially epsom salts, to form insoluble barium sulphate would be the chemical antidote which would logically be inferred from the laboratory work, but of necessity these sulphates would have to be frequently administered, and their value, after histological changes in the organs have occurred, remains to be settled. But the treatment of acute cases of barium poisoning in man is not always successful, even when sulphates combined with symptomatic treatment are employed. The conditions under which sulphates fail to precipitate barium must be considered.
>
> Loco plants grown on certain soils are inactive pharmacologically and contain no barium. In drying certain loco plants the barium apparently is rendered insoluble, so that it is not extracted by water, but can be extracted by digestion with the digestive ferments. To be poisonous the barium must be in such a form that it it can be absorbed by the gastro-intestinal tract.

There are plants with barium salts which are not injurious.

Dr. Marsh found that it is easy to kill the woolly loco weed (*A. mollissimus*) in fenced pastures because it occurs in small patches. The stemless loco weed is of wider distribution and, when in fenced pastures, can be killed but not so easily when it occurs on the ranges. He recommends treatment as follows:

> In regard to the second phase of remedial work, it was found that locoed cattle can in most cases be cured by a course of treatment with strychnin, while locoed horses can generally be cured by a course of treatment with Fowler's solution. The animals under treatment must not be allowed to eat the loco weed and should be given not only nutritious food but, so far as possible, food with laxative properties. To this end, magnesium sulphate was administered to correct the constipation which is almost universal among locoed animals. It should be noted, too, that magnesium sulphate may serve to some extent as an antidote to the poison.

Dr. C. Dwight Marsh[1] in a recent publication in speaking of this plant as well as the White Loco Weed and the experimental work of the Department of Agriculture, states that they are the weeds which produce the disease from Montana to northern New Mexico, Arizona and in western Texas, but there are many locoed animals where these two species do not grow. In California,

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[1] The Loco-Weed disease. Farmers' Bull., U. S. Dept. Agr., 380. 1909.

Arizona and New Mexico there occur other leguminous plants which are known as loco weeds. Some of these are poisonous and the symptoms of locoed animals and the pathological findings are similar to those produced by the plants found in the eastern Rockies, especially in Colorado, where the purple loco is abundant. Dr. Crawford finds barium in them which he thinks may be connected with the poisonous effects of the plants. In California the *A. diphysus, A. arizonicus, A. Thurberi* and *A. Bigelovii* are called "rattleweeds" and have been suspected. They are being studied by Dr. Crawford of the Bureau of Plant Industry.

In his most recent paper on Loco Poisoning* Dr. Marsh affirms Dr. Crawford's opinion that the purple loco weed (*Astragalus mollisimus*) is more poisonous than the white species (*Oxytropis Lamberti*). Dr. Marsh adds this caution, that since such animals are extremely sensitive to strychnin, it has been found necessary to give it in small doses. He says:

> The daily doses should not ordinarily exceed three-twentieths or four-twentieths of a grain, or 0.009 to 0.012 of a gram. Large animals may take as much as one-half grain, but this is a maximum dose and often will be found too much. It was also found that sodium cacodylate when given to cattle in hypodermic injections of 6 grains, or 0.4 grains, daily, commonly gave beneficial results. The best results, however, were obtained from the use of strychnin and Fowler's solution as already outlined.
>
> It may be added, in regard to the question of immunity, that loco poisoning comes on in a slow and cumulative manner so that there is no possibility of animals becoming immune.

It does not seem that the above is final in regard to all of the loco weeds. It is hardly likely that Profs. Power, Sayre, Gambier, and others have been entirely wrong in regard to their conclusions. When we find that related plants have strongly toxic properties we may expect to find the same properties also in some of these plants.

17. *Oxytropis* DC. Stemless Loco Weed

Perennial herbs or sometimes shrubby, generally acaulescent, with numerous tufts of short stems covered with scaly stipules. Flowers in racemes or spikes; calyx teeth nearly equal; petals clawed; standard, erect, keel erect; stamens appendaged; diadelphous; pod more or less 2-celled or 1-celled sessile or stalked. About 125 species of the North Temperate regions. Most of our species are western. Several of our species are known to be poisonous to live stock. The following species of this genus are classed with the loco weeds: *O. Lamberti, O. deflexa* and *O. multiflorus*. According to Greshoff the young leaf of *Oxytropis lapponica* has an extremely bitter taste; there is also an indication of saponin. On analysis the leaf was found to contain hydrocyanic acid. Greshoff also found hydrocyanic acid in the seeds of *O. sulphurea*.

Oxytropis Lamberti Pursh. Purple or Stemless Loco Weed

Nearly acaulescent perennial herbs or shrubby plants, with tufts of very numerous short stems coming from a hard and thick rootstock containing many scaly stipules; stems and leaves are covered with silky and fine appressed hairs, or smooth; leaves pinnate; leaflets linear; flowers racemose or spicate, rather large and elongated, purple, violet, or sometimes white; stamens diadelphous; keel tipped with a sharp projecting point.

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* Farmers Bull. U. S. Dept. Agr. 380:16.

Distribution. Western Minnesota, Western Iowa, and Missouri to Texas, and New Mexico, north to British Columbia, and northwest territory.

Poisonous properties. The stemless loco weed is one of the most characteristic loco weeds of the West. The symptoms of poisoning are similar to those produced by the woolly loco weed described at length elsewhere. The poisonous substance has not been isolated. An alkaloid, however, has been reported by Prof. Prescott. Chesnut and Wilcox, in speaking of the history of the loco poisoning in Montana, say that in Colorado the plant which is most commonly known as loco weed is *Astragalus mollissimus.* In Montana, on the other hand, the plants most generally called loco weeds by the stockmen are species of *Aragallus* (*Orytropis*). "The species which is most concerned in causing the loco disease in Montana is the *Aragallus spicatus* and is closely related to *Oxytropis Lamberti*," Stockmen are of the opinion that a condition somewhat similar to loco poisoning may be brought about by eating undue quantities of alkali soil.

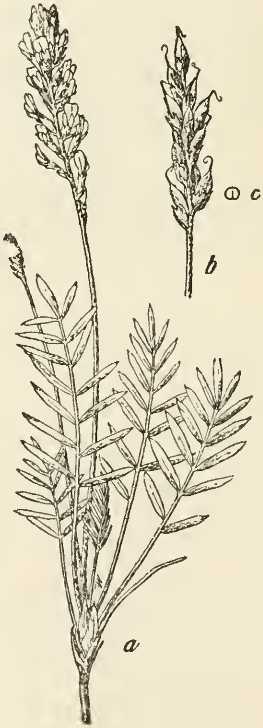

Fig. 313. Stemless or Purple Loco Weed a, Plant. b, Seed pods. c, Seed. U. S. Dept. Agr.

It should be stated also that the larvae of sheep bot flies, which are frequently found in the frontal sinuses of the head, can not possibly be considered the cause of the nervous symptoms characteristic of the loco disease, for the reason that these larvae are not found in greater abundance in locoed than in healthy sheep. For the same reason the presence of the common tape worm (*Taenia serrata*) in the small intestines and bile duct of sheep can not be considered as the cause of the locoed condition. These worms are almost

> universally present in the intestines of sheep, and under ordinary conditions do not cause any recognizable disturbances. The disease of sheep known as "gid" is not to be mistaken for the loco disease and, furthermore, is not prevalent in this country. No indications were found during the post-mortem examinations that the walls of the stomach were affected to any appreciable extent by the action of loco weeds, although these plants were invariably found in the stomach contents of such sheep. In the majority of cases no apparent changes have been produced in the spleen, liver, or kidneys. In some instances a slight congestion of the intestines was noticed. The cerebral membranes were in all cases somewhat congested. This condition is probably one of the immediate physical causes of the mental excitement exhibited by locoed animals. Post-mortem examinations of locoed horses disclosed the same conditions as those found in the sheep.

They made a number of experiments with a young Belgian hare and other rabbits, using the water extract of the leaves, and it was shown that this was not an acute poison if from 10 to 15 cubic centimeters of the liquid were administered. An acute case of loco disease was observed in an old ewe with a lamb at her side. She had eaten considerable quantities of the white loco weed (*Aragalus spicatus-Orytropis spicatus*). A slight locomotor ataxia was manifested. The eyelids twitched rapidly and there was a slight champing of the jaws. Each attack lasted from 1 to 2 minutes, and the intervals between the attacks were about 5 minutes.

> The lips and eyelids twitched violently and the jaws were moved upon one another with such force that the sound could be heard for a distance of 200 yards.

Similar symptoms were observed in the lamb, which died in the afternoon.

Locoed sheep are exceedingly difficult to herd.

> It is the universal experience of sheep raisers that locoed sheep are exceedingly difficult to herd. The sheep may, without a moment's warning, stray away from the band, each one in a different direction, and it is easy to understand how nearly impossible it is to prevent such a band of sheep from becoming separated. Besides giving the herder much trouble in directing the course of the band on the range, locoed sheep also refuse to enter the corral at night, and under any and all circumstances may suddenly manifest perplexing stubbornness.

These writers did not observe many locoed cattle, but the symptoms are essentially the same as in sheep and horses. In regard to post-mortem conditions, they say:

> Numerous autopsies made on locoed sheep and horses revealed conditions which, though fairly uniform, did not constitute a well-defined series. We made a large number of post-mortem examinations upon bodies of locoed sheep which had been killed and bled immediately before examination. In these cases there was no lesion or marked change in the alimentray tract. A slight congestion of the membranes of the brain was to be observed in all cases. The lungs and heart were apparently not affected. The voluntary muscles were of a paler color than under normal conditions, and the fat tissue was considerably reduced in quantity.

As to remedies, the following suggestions have been made:

> Locoed sheep should be removed from the band and fattened for market on alfalfa or other forage plants, as above explained.
>
> The immediate isolation of locoed sheep is advisable in order to prevent the habit from spreading in the band.
>
> It seems desirable to give sheep a regular and abundant supply of salt in order to prevent the development of any perversion of the appetite.
>
> Locoed horses are used to the best advantage as draft animals, but they must be maintained in good condition and prevented from eating loco weeds.

Dr. Marsh recommends to cut the roots below the crown of buds. A man with a spade can destroy a large number of plants in a day. The seeds however retain their vitality for some years, hence the field will have to be gone over again. That this method will effectively destroy the plants has been demonstrated by the U. S. Dept. of Agr. atHugo, Colorado. The larvae of a moth (*Walshia amorphella*) feeds on the purple loco weed and this insect, Dr.

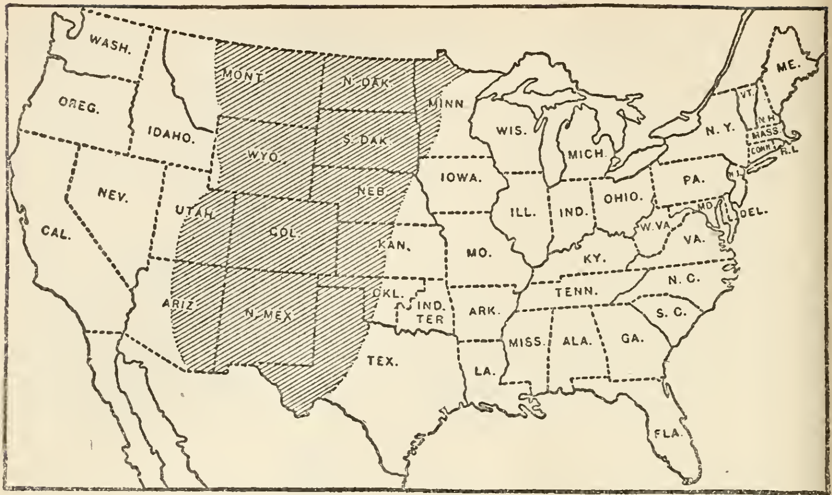

Fig. 313a. Map showing distribution of stemless loco weed (*Oxytropis Lamberti*). The plant reaches western Iowa on the loess bluffs where it is abundant. The disease however has never been reported so far as I know from this section of the state. Map after Marsh, U. S. Dept. Agr.

Marsh thinks, will help to keep the weed in check if the insect will not lose its efficiency in the course of a few years.

18. *Vicia* (Tourn.) L. Vetch or Tare

Herbs, generally of trailing or climbing habit, with pinnate tendril bearing leaves; flowers generally racemose; calyx 5-cleft or 5-toothed, divisions nearly equal; corolla with the standard clawed and the wings adherent to the keel; stamens diadelphous or monadelphous; pod flat, 2-valved with several seeds; seeds globular; embryo with thick cotyledons. About 120 species, widely distributed. Some species used for forage, especially in Europe. The hairy vetch (*V. villosa*) has been widely distributed in the west because of the drouth resisting qualities. Our most common native species is the American vetch (*V. americana*) which might well be introduced as a forage plant.

Vicia sativa L. Common Vetch

A smooth or slightly pubescent annual from 1-2½ feet high with simple stem; leaflets 5-7 pairs, obovate-oblong to linear, notched or mucronate at the tip; the 1 or 2 nearly sessile flowers are borne in the axils of the leaves; flowers bluish purple; calyx teeth about as long as the tube; pod linear, several seeded, seeds black.

Distribution. From eastern Canada to Northwest Territory, New England to the Carolinas, west to Missouri and northward, generally in the wheat growing sections of the northern and western states. This is another weed commonly found in wheat screenings, abundant in the northwest.

Poisonous properties. In Europe it is the cause of tympanites. Dr. Schaffner, in The Ohio Naturalist, states that caution must be observed in feeding this plant to pigs. It is not injurious to cows. The seeds of this Vetch are often

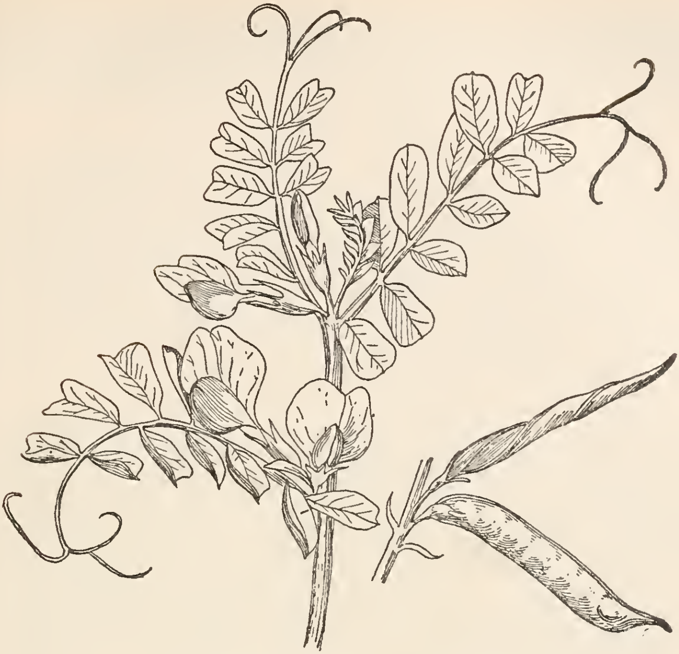

Fig. 313b. Common Vetch. (*Vicia sativa*)

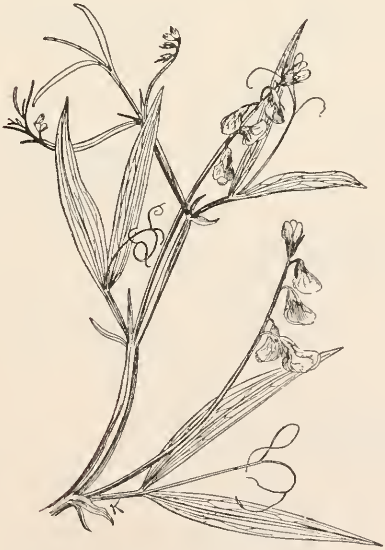

Fig. 314. Common Vetch (*Lathyrus silvestris*). The seed of this plant poisonous to stock. Charlotte M. King

found in screenings and fed in large quantities to cattle. As far as the writer knows, there are no cases of poisoning recorded from eating the screenings of this seed. The substance *vicin* $C_8H_{15}N_3O_6$ has been found in the seeds of this species. *Convincin* $C_{10}H_{15}N_3O_8+H_2O$ also occurs in this species and in *V. Faba*. *Citric acid* $C_6H_8O_7+H_2O$ is found in *V. sativa*.

19. *Lathyrus* (Tourn.) L. Vetchling. Everlasting Pea

Mostly perennial, herbaceous vines although there are a few erect herbs, generally smooth, with pinnate, usually tendril-bearing leaves; flowers in racemes or solitary; calyx oblique or gibbous at the base, upper teeth sometimes shorter than the lower; corolla larger than that of *Vicia*, wings adhering to keel; style dilated and rather flat above, hairy along side next to free stamen; stamens 10 (9 and 1, or monadelphous below); ovules numerous; pod flat, sometimes terete, 2-valved, continuous between the seeds, dehiscent.

About 100 species are distributed throughout North America and a few others are found in South America and the mountains of tropical Africa. One species, *L. sylvestris*, is considered poisonous, in its native home in the Carpathian Mountains. It contains certain alkaloids which, by the process of cultivation have become eliminated so that in many localities at the present time it is considered a good forage plant and is relished by horses. In the western United States, the prairie vetchlings *L. ornatus* and *L. polymorphus*, and the marsh vetchling *L. palustris* are considered valuable forage plants, the latter forming a very important part of the hay and adding materially to its feeding value. *L. venosus* and *L. ochroleucus* occurring in similar localities are much less valuable. A form of intoxication, known as Lathryism, is said to be caused by different species of Lathyrus.

In Dr. Wilson's "American Text-Book of Therapeutics," Victor C. Vaughan translates the following account of Lathyrism from Kobert's work "Intoxikationen:"

> By Lathyrism we mean an intoxication that was known to the contemporaries of Hippocrates, and which was caused by the seeds of at least three species of vetch, *Lathyrus hirsutus*, the red vetch, *Lathyrus sativus*, the German vetch, and *Lathyrus Clymenum*, the Spanish vetch. In Spain, France, Italy, and in certain parts of Africa and India there have repeatedly appeared, from the eating of the seed of the vetch, epidemics of a disease that especially affects males and which induces a transverse myelitis with motor and sensory paraplegia. The paralytic symptoms gradually disappear, but there remains spastic tubes with heightened tendon-reflexes attributed by Proust to secondary degeneration of the lateral columns, while Strümpell considers the case a typical spinal paralysis. However, the symptoms may wholly disappear and recovery be apparently complete. Men and animals, especially horses, are affected in the same manner. Duvernoy described the disease in 1770; Doir saw it follow the eating of vetch-bread in 1785; Despranches observed it in France in 1829, and Pellicotti in the Abbruzzo mountains in 1847. Reports of the disease were made by Irving, in India, in 1861 and 1869, and by Bourlier in Africa in 1882. In 1883, Marie published in Le Progrès Medical a review of the literature of the subject and more recently Schuchardt has done the same. . . . . . Hogs are killed quickly by the vetch. Horses suffer from paralysis of the recurrent laryngeal nerve, necessitating tracheotomy. More chronic poisoning causes paralysis of the posterior extremities, and death. Méricourt believes the disease beri-beri is due to a similar intoxication, but this is denied by Marie and others. In horses there is atrophy of the muscles of the larynx, especially of the cricoarytenoideus posticus and lateralis, also of the thyroarytenoideus. The left recurrent laryngeal nerve is much wasted. Microscopic examination shows the muscle greatly atrophied, without striation, and undergoing fatty degeneration. In the central nervous system one finds atrophy of the ganglion-cells in the vagus center and of the multipolar ganglion-cells in the anterior horns of the cord.

Attempts to isolate the poison have not succeeded. Teilleux found an acid that induced typical effects upon rabbits. Bourlier found an active alkaloid in the alcohol-ether extract of the seeds, and poisoned birds with it. Astier isolated a volatile alkaloid by the Stas method, and he thus explains the fact that long-continued heating at a high temperature renders the seeds inert.

20. *Cicer* L. Chick pea

Calyx tube oblique or gibbous posteriorly; lobes nearly equal or the two upper somewhat shorter, conniving; standard ovate or nearly orbicular, narrowed into a broad claw; wings obliquely obovate, free; keel somewhat broader, incurved, dilated; anthers uniform; ovary sessile 2-8 ovuled; style filiform, incurved or bent, beardless; stigmas terminal, legume sessile, ovoid or oblong, turgid, 2-valved; seeds sub-globose or irregularly obovoid; funiculus scarcely dilated, hilum small; cotyledons thick; radicle short, slightly incurved or nearly straight.

Cicer arietinum L. Chick pea

Annual herbs, or perennial often glandular-pubescent; leaves pinnate, petiole terminating in a small tuft of spinescent hairs or in an odd leaflet; leaflets dentate or incised without stipels; stipules foliaceous oblique, often dentate or incised; flowers white, blue or violet; solitary pedunculate, or few pedicelled; bracts small; bractlets 0. About 14 species, especially in the eastern Mediterranean and in Central Asia—extending westward.

Distribution. Cultivated in the Rocky Mountains and in the Southwest. Also extensively in Southern Europe and tropical Asia. Considered an excellent food plant.

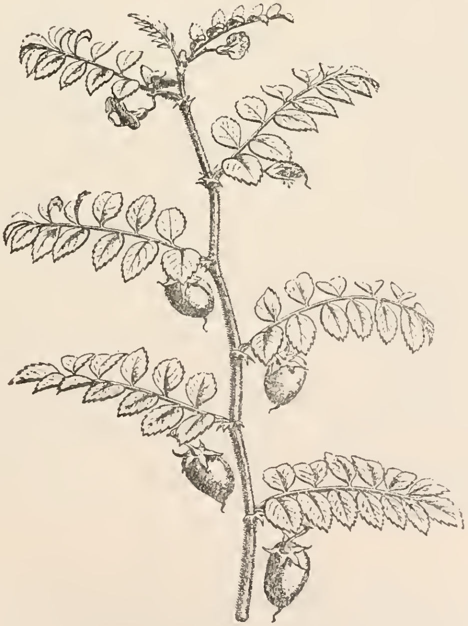

Fig. 315. Chick pea (*Cicer arietinum*). (After Faguet).

Poisonous properties. Friedberger and Fröhner in Veterinary Pathology give the symptoms from Cicer poisoning:

> In horses roaring and difficult breathing, owing to paralysis of the laryngeal muscles; paralysis, weakness in the loins, suffocation. Post-mortem reveals nothing of moment. Therapeutics: Change of fodder; tracheotomy.

21. *Phaseolus* L. Bean

Usually vines with pinnately 3-foliate leaves, stipules and racemose flowers; calyx 5-toothed or 5-cleft, the upper teeth more or less united; standard orbicular recurved, spreading; keel spirally coiled enclosing the stamens and style; stamens diadelphous, 9 and 1; style bearded; pod linear 2-valved, several seeded; seeds with large embryo. About 170 species mostly of tropical regions; 12 species native to southern states. The common bean (*Phaseolus vulgaris*), native to tropical America is widely cultivated. The scarlet runner (*P. multiflorus*) is widely cultivated as an ornamental plant and is said to be poisonous. The *P. Mungo* is cultivated in the tropics.

Phaseolus lunatus L. Lima Bean

A twining plant with racemose flowers shorter than the leaf; pod broad and curved, scimitar shaped; seeds few, large and flat; some dwarf, some with long twining stems.

Distribution. Widely cultivated, native to South America.

Poisonous properties. Several cases of poisoning from the use of lima beans are reported. L. Guignard, according to an abstract in the Experiment Station Record, has determined this to be due to hydrocyanic acid. He says: "A number of forms that have been described as distinct species are by the author believed to be varieties or cultural forms of *P. lunatus.* Those principally studied were the white and colored Java beans, Burma or white Indian beans, Sieva beans, Cape beans, which are extensively cultivated in Madagascar, and Lima beans. These different varieties are widely cultivated and extensively used as food, although a number of fatalities have been attributed to their use. Descriptions of the different varieties and detailed reports of the chemical studies are given.

Practically all varieties of *P. lunatus,* whether wild or cultivated were found to contain the principle which when acted upon by an enzyme yields hydrocyanic acid. The proportion of hydrocyanic acid varied from almost inappreciable amounts in some of the more improved forms, like the Lima bean, to as much as 60 to 320 mg .per gm. dry weight in certain varieties of Java beans. It was found impossible by cooking to remove all the cyanogenetic compound in Java beans. Prolonged boiling extracts the greater part, but it is merely withdrawn and not destroyed, and if the water is absorbed it presents the same danger as the beans themselves, since either in the alimentary tract or in the blood are sufficient ferments to act upon the dissolved glucoside, resulting in the liberation of hydrocyanic acid.

GERANIALES

Herbs, shrubs or trees; petals usually present and generally polypetalous; sepals mostly distinct; stamens few, rarely more than twice as many as the sepals, opposite them when as many; compound ovary superior. Contains the families *Geraniaceae, Oxalidaccae, Tropaeolaceae, Linaceae, Erythroxylaceae, Zygophyllaceae, Rutaccae, Simarubaceae, Burseraceae, Meliaccae, Malpighiaceae, Polygalaceae* and *Euphorbiaceae.* The family *Tropacolaceae* contains the nasturtiums (*Tropaeolum majus* and *T. minus*) frequent in cultivation, the fruits of the species being used for pickles. *T. Lobbianum* is a showy greenhouse plant. The *T. tuberosum* of Peru produces a tuberous root used for food in Bolivia, cooking dispelling the unpleasant flavor.

Dr. Halsted states that some persons have suffered from an inflammation on the hand caused by handling the garden nasturtium.

T. majus contains *glucotropaeolum,* similar to the essential oil of mustard. The family *Burseraceae* contains *Commiphora abyssinica* furnishing myrrh, and Almacigo (*Bursera simaruba*) the most characteristic tree of Porto Rico and one which furnishes a resin known in commerce as "chibon." The family *Meliaceae* includes mahogany (*Swietinia Mahogoni*) a valuable timber tree of the Antilles; myrtle (*Melia Azedarach*), widely cultivated in the South as an ornamental plant, the fruit of which contains *mangrovin* and is said to be poisonous, the West Indian cedar (*Cedrela odorata*), which furnishes a valuable wood used for furniture, cigar boxes, shingles, etc.; and *Trichilia emetica,* which yields an oil and tallow. The carapa oil made from the seeds of *Carapa procera* is toxic for insects. The family *Zygophyllaceae* furnishes lignum-vitae (*Guaiacum officinale*), a heavy wood used in machinery and casting work.

The ratsbane, broken-back or mendis (*Chailletia toxicaria*) of the family *Chaillctiaccae* is much used in Sierra Leone country of Africa for poisoning; it is placed in water to poison enemies and live stock. According to Dr. Renner "No one in this colony, it would appear, dies from natural causes." Dr. Renner found the cause of this mysterious trouble to be due to poisoning from ratsbane poison. In one case, a laborer was poisoned from "having eaten some fish on which the ground fruit of *Chaillctia toxicaria* had been strewn for the purpose of killing rats." This shrub and an allied species are common in Upper Guinea and Senegambia. Drs. Frederick B. Power and Frank Tutin who made chemical and physiological examination of the fruit of *Chailletia toxicaria* found that the fruit contained neither an alkaloid nor a cyagenetic glucoside although a glucoside of this character is said to occur in South African *C. cymosa.* The ratsbane contains a resinous substance which is extremely poisonous, but a toxin could not be isolated. The syrup prepared from the resin when given to a dog caused delirium and epileptiform convulsions soon followed by death. Drs. Powers and Tutin found that the fruit of this plant contains two active principles, one of which causes cerebral depression or narcosin and that the poison which causes convulsions is cumulative in its effect.

To the family *Erythroxylaceae* belongs coca (*Erythroxylon Coca*) which contains a number of alkaloids as follows: *cocain* $C_{17}H_{21}NO_4$, *cinnamylcocain* $C_{19}H_{23}NO_4$, *truxillin* (a) $(C_{19}H_{29}NO_4)_2$ *truxillin* (b) $(C_{19}H_{23}NO_4)_2$, *benzoylecgonin* $C_{16}H_{19}NO_2$, *tropa-cocain* $C_{15}H_{19}NO_2$, *hygrin* $C_8H_{15}NO$, *cusoyhgrin* $C_{13}H_{24}NO_2$. The injurious effects of cocain are well known. Dr. Winslow says:

> Solutions of cocain (4.10 per cent), applied to mucous membranes, produce perfect local anaesthesia by paralyzing the sensory nerve endings. Cocain exerts a local anaesthetic action upon the gastric mucous membrane, and in this way lessens the appetite and sometimes stops vomiting. Intestinal peristalsis is increased by moderate doses, but is decreased and destroyed by the paralytic action of large doses. The action of cocain upon the heart and

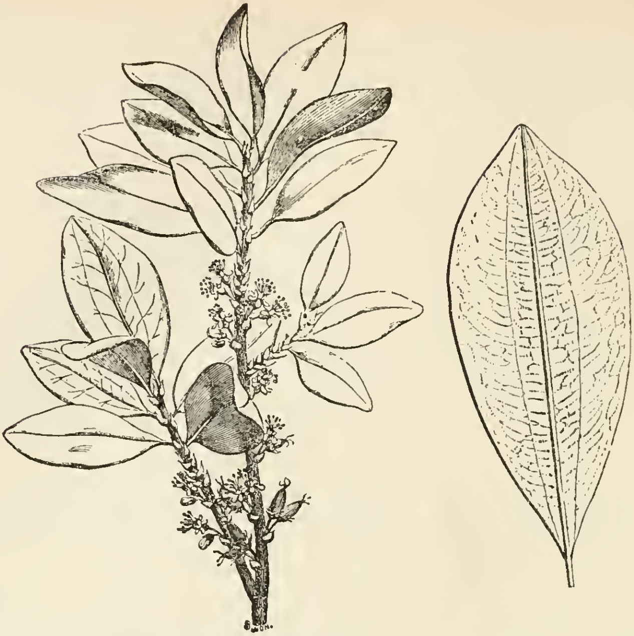

Fig. 316. Coca-tree (*Erythroxylon coca*). Furnishes the coca of commerce. (After Faguet).

vessels is not very marked, except in poisoning. The alkaloid is, however, a slight cardiac stimulant in moderate doses, increasing the pulse-rate and tension. The action upon the heart is caused by depression of the cardio-inhibitory centres, and sometimes as well by depression of the cardiac inhibitory ganglia. Vascular tension is increased because of stimulation of the medullary vasomotor centres, smooth muscle of the walls, and because of the increased action of the heart. On the other hand, both minute and large doses may diminish the pulse rate.

Cocain is a respiratory stimulant in medicinal doses, but a paralyzant in toxic amounts. The respiratory centres are first stimulated and the breathing is made deeper and quicker. Depression and paralysis of the respiratory centres follow; cyanosis supervenes, and the respirations are shallow and irregular. Death occurs from asphyxia. In man, an amount of cocaine exceeding gr. ¾ should not be employed under the skin, or upon mucous membranes, and death has occurred in susceptible patients from even smaller doses. The most powerful action follows the use of cocain in very vascular parts, as about the face. One half a grain of cocain given subcutaneously to a girl eleven years old, was followed by a fatal result in 40 seconds, and the writer has seen violent convulsions produced by the instillation of a few drops of a 2 per cent. solution into the eye of a man. On the other hand, spontaneous recovery has obtained in the human subject after the ingestions of 22 grs. of the alkaloid. In the horse, the toxic dose of cocain causes restlessness and excitement. dilated pupils and salivation, culminating within an hour in a state of acute mania and intense excitement. These symptoms are followed by gradual recovery after a lapse of a few hours. Three grains of cocain given under the skin, will sometimes induce nervous excitement in susceptible horses. The treatment of dangerous forms of cocain poisoning, with respiratory and heart failure, consists in the use of rapidly acting stimulants,—as nitroglycerin upon the tongue, and strychnin, atropin and brandy subcutaneously.

Families of Geraniales

Flowers regular or nearly so, petals present usually as many as the sepals; flowers perfect; leaves not punctate.

Herbs.
  Capsule splitting into 5 carpels; leaves 3-foliolate or dissected.......... .... Geraniaceae.
  Capsule 2-5 celled not splitting into carpels.
    Stamens 2-3 times as many as the petals.
    Leaf 3-foliolate ....Oxalidaceae.
    Stamens as many as the petals ....Linaceae.
Trees or shrubs with compound leaves; leaves often punctate.
  Leaves punctate ....Rutaceae.
  Leaves not punctate ....Simarubaceae.
Flowers irregular; petals 3, stamens diadelphous or monadelphous..Polygalaceae.
Flowers regular generally apetalous, monoecious; carpels mostly 3; generally herbs with milky juice ....Euphorbiaceae.

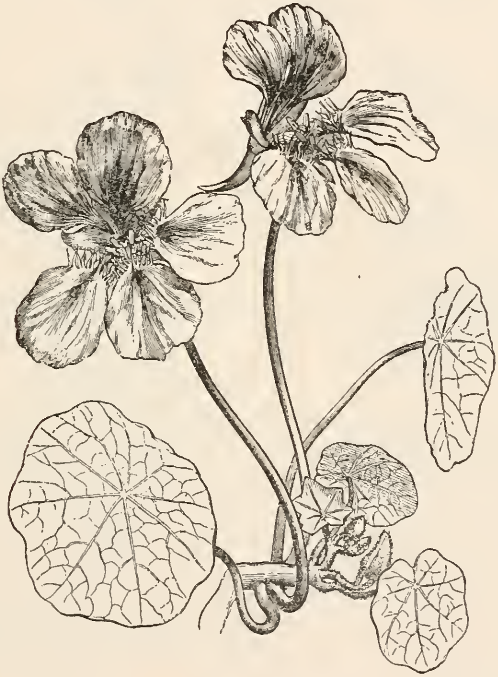

Fig. 317. Nasturtium (*Tropaeolum majus*). Flowering branch. (After Faguet).

GERANIACEAE

Herbs with alternate or opposite leaves; flowers perfect, regular, 5-nerved, hypogynous; stamens as many or twice as many or more than the petals; ovary 1, usually 5-lobed; ovules 1-2 in each cavity; fruit capsular. About 450 species of wide distribution. Native to the tropics and temperate regions of both hemispheres. Many plants of this order are frequently cultivated; among these are the South African pelargonium, commonly called the geranium, which contains *geraniol* $C_{10}H_{18}O$. The sharp points of the fruit of some are injurious.

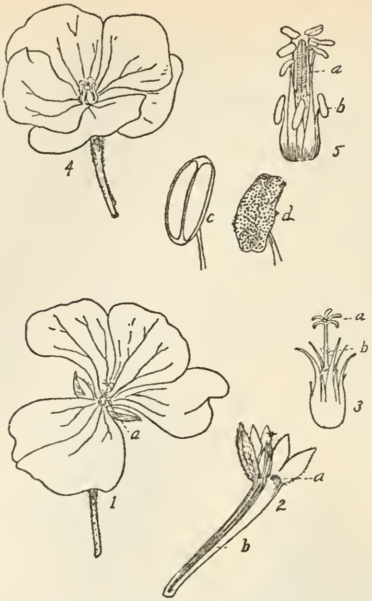

Fig. 318. Cultivated Geranium (*Pelargonium zonale*). 1, 4, Flower; b, c, d, Stamens; a, Stigmas.

frequently entering the flesh and in some cases this mechanical injury has produced death in sheep, just as in the case of *Stipa*. The *Geranium Robertianum* has a disagreeable bitter taste.

Erodium L'Her. Storksbill

Herbs with opposite or alternate stipulate leaves; flowers nearly regular, axillary or umbellate; sepals 5, imbricated; petals 5, hypogynous, the upper slightly smaller; glands of the disk 5, alternate with the petals; stamens 10; anther bearing 5, and as many sterile filaments; ovary deeply 5-lobed and 5-celled, beaked by the united styles, 5 in number; lobes of the capsule 1-seeded; the style when mature breaks away elastically and is coiled spirally; tails of carpels hairy on the inside; seeds not reticulated. The 65 species found in temperate and warm regions. Some species have become widely distributed because the seeds cling to the fleece of animals. Some species are troublesome in western United States.

Erodium cicutarium L'Her. Alfilaria or Storksbill

A hairy, tufted annual with low spreading stems; plant viscid or sticky; leaves pinnate or once to twice pinnatifid; flowers in umbel-like clusters, purple or pink; fruit hairy on the inside and spirally twisted when ripe. The *E. moschatum* is a stouter plant which occurs occasionally eastward.

Distribution. This plant is common upon the Pacific Coast especially California, occurring in grain fields and waste places. It is also abundant in dry soils in the Salt Lake basin and from Colorado to Texas; occasionally found in the eastern states and Manitoba. Native to the Old World. The weed is commonly scattered by animals. It is injurious to wool.

Injurious properties. Species of Erodium, like those of Stipa, have in some cases sharp pointed calluses which bury themselves in the flesh and inflict injuries to animals. Our common species is but slightly troublesome in this way. The carpels of the *Erodium* get into the fleece of sheep and thus the wool is rendered somewhat less salable.

E. moschatum is injurious.

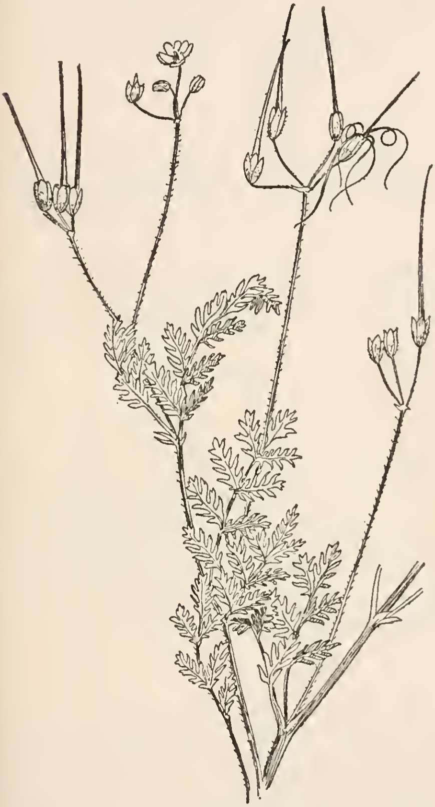

Fig. 319. Hemlock Stork's Bill (*Erodium cicutarium*). This widely distributed plant sometimes causes mechanical injuries in animals. (Charlotte M. King).

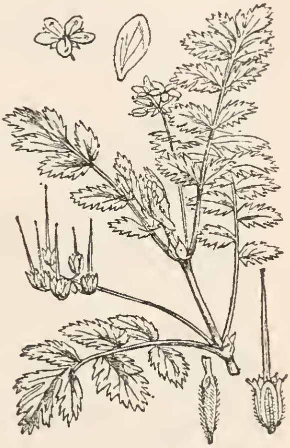

Fig. 320. Musk Erodium (*Erodium moschatum*). (After Fitch).

OXALIDACEAE

Generally herbs, frequently with bulbs; acid juice; leaves palmate, with obcordate leaflets; flowers regular, 5-merous; stamens 10-15; ovary 5-celled; carpels with few or many ovules, loculicidal. A small order of 250 species chiefly tropical.

Oxalis L. Sorrel, Oxalis

Annual or perennial herbs with sour juice; often bulbous with alternate, digitately compound leaves of 3 leaflets; flowers in umbel-like clusters, solitary or several flowered, regular, often dimorphic or trimophic; sepals 5; petals 5;

stamens 10; pistil 1; ovary 5-celled; ovules several in each cell; 5 separate styles; pod 5-celled, opening loculicidally; seeds 2 or more in each cell, the outer coat dehiscent; embryo large, endosperm present. The 250 species chiefly found in the tropics. The *Oxalis violacea* with violet corolla is a common plant in woods and prairies. The *O. corniculata*, a yellow flowered species, occurs from Pennsylvania to Illinois. The fresh juice of this is said to be an antidote against poisoning from the seeds of Jimson weed. Several South American species like *O. flava* and *O. Ortgiesi* are cultivated indoors. The *O. tetraphylla* and *O. lasiandra* with their crimson flowers are also handsome for indoor cultivation. The *O. crenata* of Peru is cultivated for its tuberous roots.

Oxalis violacea L. Violet Wood Sorrel

Perennial with brownish bulb and ciliate scales; leaves smooth; leaflets obcordate, the midrib sometimes sparingly hairy; flowers in cymose clusters; sepals 5; petals 5, violet purple; capsule ovoid; seeds flattened, rugose-tuberculate.

Distribution. New England to Florida and New Mexico.

Poisonous properties. Dr. Schaffner notes a case of poisoning as follows:

"A case is recorded of a boy being thrown into violent convulsions by eating a considerable quantity of the leaves."

Prof. Hyams states that children have been known to die from constantly eating the raw herbs of *O. grandis.*

LINACEAE. Flax Family

Herbs, rarely shrubs; stipules small or none; flowers regular and symmetrical, hypogynous; sepals 5, rarely 4, imbricated and persistent; petals 5, or rarely 4, convolute; stamens 5, monadelphous at the base, alternate with the petals; pistil 1, 2-5-celled; styles 2-5; fruit capsular; seeds 1-2 in each cavity; cotyledons large, flat, without endosperm or with a small amount. A small order of 4 genera and 90 species, mostly in the genus *Linum.*

Linum (Tourn.) L. Flax

Herbs, sometimes with a woody base with tough fibrous bark; leaves sessile; stipules wanting or a pair of glands; flowers in cymes, racemes, or panicles; sepals 5; petals 5, soon falling; stamens 5; pistil 1; ovary 4-5-celled or becoming divided by false partitions, making 10 cells; seeds shining with a mucilaginous coat; large cotyledons. Several species commonly cultivated for ornamental purposes. The blue-flowered *L. perenne* of the Rocky Mountains, and the red garden flax (*L. grandiflorum*) a hardy annual from North Africa, are cultivated.

Linum usitatissimum L. Flax. Linseed

Annual; stem corymbosely branched at the tip; acuminate sepals; flowers broad; petals large, blue. Widely cultivated in the North and frequently spontaneous.

Poisonous properties and uses. The blue-flowered annual (*L. usitatissimum*) has been cultivated for centuries. The fiber has been found among the remains of the Swiss Lake dwellers. The ancient Egyptians as well as the Greeks and Romans also used the fiber for the manufacture of cloth. It is extensively cultivated in various European countries, fine fiber being produced in Belfast, Ireland; Brussels, Belgium; in Russia, and the Nile region. The seeds are also used extensively for making linseed oil. The chief regions where it is cultivated in North America are the Dakotas, Minnesota, Nebraska and Manitoba. Russia also cultivates the plant for the oil. The seed contains *linolleic acid* $C_{18}H_{32}O_2$, and is rich in oil. The compressed refuse is manufactured into oil cake, which is used for cattle food. The flax oil found in the seed of the plant is about one-third of its weight. Commercially, between 20 per cent and 30 per cent are obtained. When fresh it is without color and has little taste. The commercial oil is yellow and has a repulsive taste. On exposure to the air after having been heated with oxide of lead, it dries up to a transparent varnish consisting chiefly of *linoxyn* $C_{38}H_{54}O_{11}$. In medicine the flax seed is used in the form of a poultice, which is made of the pulverized seed. When oil cake or oil meal is fed in concentrated form it produced digestive trouble to hogs, frequently resulting in death. Dr. Schaffner states that it causes death to cattle, probably due to the prussic acid evolved from the plant when wilting. This substance has been reported.

Friedberger and Fröhner state that it causes violent colic, inflation, diarrhoea, staggering, palpitation, death with convulsions; autopsy shows gastro-enteritis and signs of axphyxiation.

Linum rigidum Pursh. Large-flowered Yellow Flax

An herbaceous glaucus or slightly puberulent annual with rigid angled branches from 1-2 feet high; leaves narrow, erect, usually with stipular glands; flowers large ,yellow; sepals acute or awn-pointed, glandular, serrulate; petals cuneate-obovate longer than the sepals; styles separate only at the summit; capsule 5-valved and ovoid.

Distribution. Loess soil of western Iowa to Missouri, Texas, Mexico to Arizona and Manitoba.

Poisonous nature. According to Chesnut the plant is reported as poisonous to sheep in the Pecos Valley, Texas.

RUTACEAE. Rue Family

Trees, shrubs, or herbs with simple, compound, alternate or opposite leaves, glandular, with punctate dots without stipules; flowers mostly in cymose clusters, polygamo-dioecious hypogynous, or perigynous; sepals 4-5; petals 4 or 5; stamens of the same number or twice as many, distinct, inserted on the receptacle; pistils 2-5, distinct or one compound; 2-5 carpels raised on an annular disk; embryo large, curved or straight; endosperm fleshy or none.

About 875 species, mostly in tropical regions of South Africa and Australia. Few representatives in North America. Two species of prickly ash (*Zanthoxylum americanum* Mill and *Z. Clava-Herculis* L.) and our hop-tree (*Ptelea trifoliata*) are common in the United States. The fruit of the hop-tree is used in Russia as a substitute for hops. A bitter alkaloidal principle occurs in *Xanthoxylum.* The gas plant (*Dictamnus albus*) a viscid glandular plant with strong aromatic scent is commonly cultivated. The common rue (*Ruta graveolens*), a native to Europe, is sometimes cultivated in country gardens. It has a strong disagreeable odor, and is so acrid that it will even blister the hands. It contains an acrid narcotic poison. The cork tree (*Phellodendron amurense*) from the Amur region, is occasionally cultivated. The most important genus of the order is *Citrus*. The orange (*Citrus Aurantium*) is extensively cultivated in California and Florida. *C. Aurantium var. vulgaris* is the bitter orange which has run wild in Florida and other parts of the world. It is used in the manufacture of candied orange peel. The citron (*C. Medica*) produces the oil of citron, the thick peel being used to make the citron of commerce. The lemon (*C. Limonum*), wild in northern India, introduced into Europe by the Crusaders, is now well known in cultivation in California. The lime (*C. Limetta*) is cultivated in all tropical countries, and with the lemon is used to make lime juice. It is a refreshing drink and on sea voyages is used as an antiscorbutic. The lemon and lime are forms of *C. Medica*. The mandarine or tangerine (*C. Aurantium*) having a small flattened fruit with a thin rind and rich fruit, is grown in California and China. It is hardier than the orange, but probably a form of it. The shaddock or grape fruit (*C. decumana*) with large and somewhat bitter fruit, is native to Polynesia, and in recent years has become much better known in the United States. The kumquat (*C. japonica*), native to Japan and China, produces a small and pleasantly flavored fruit. The Aegle sepiaria (*C. trifoliata*) hardy as far north as Washington, is a spiny shrub producing a many-seeded, yellow, austere fruit. Hybrids of the species and *C. Aurantium* with better and larger fruit, have been produced by Webber. The sour orange or Naranja (*C. Bigaradia*) of Porto Rico and Florida is used for stocks in all plantings on moist lands because it resists the foot-rot which affects other varieties. The Beal fruit (*Aegle Marmelos*), native of India, with fruit about the size of an orange, produces a delicious fragrant material used in medicine. Jaborandi (*Pilocarpus pennatifolius*) native to Brazil contains the alkaloid *pilocarpin* $C_{11}H_{17}N_2O_2$ and is a powerful diaphoretic. The administration of more than 5 grs. of the alkaloid is dangerous to horses when given subcutaneously. Atropin is an antidote. The alkaloid *jaborin* $C_{22}H_{32}N_4O_4$ resembles *atropin*, also the alkaloid *pilocarpidin*. The bark of angustura (*Cusparia febrifuga*) native to Venezuela contains *cusparin* $C_{20}H_{19}NO_3$ three other alkaloids and the bitter principle *angusturin*. The *C. toxicaria* of Brazil is poison

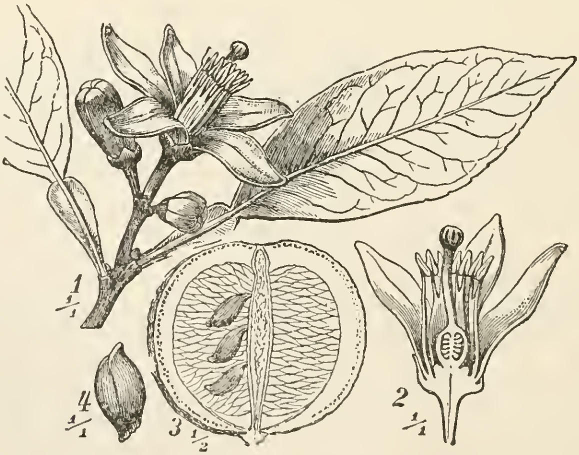

Fig. 321. Orange (*Citrus Aurantium*). 1. Flowering branch. 2. Longitudinal section of flower. 3. Longitudinal section of fruit. 4. Seed. (After Wossidlo).

ous. *Lunsia amara* contains a toxic glucoside. Citric acid is found in fruits of lemons, lime and other members of the genus *Citrus*. The glucoside *hesperidin* $C_{50}H_{60}O_{27}4H_20$ occurs in ripe and unripe fruits of *Citrus*; the resinous principle *naringin* $C_{23}H_{21}O_{12}$ in *C. decumana*. The essential oil of lemons is one of the terpens $C_{10}H_{16}$; the oil of bergamot similar to the preceding is from Bergamot; *limettin* $C_{16}H_{14}O_6$ is the bitter principle of *Citrus Medica*= *C. Limetta*. The leaves of Buchu (*Barosma crenulata*) act as a mild diuretic. It contains a volatile oil of which 30 per cent is *disophenol*, also a crystalline glucoside (*diosmin*). The *Commiphora abyssinica* contains a volatile oil consisting of *cuminol* and *eugenol*. *Aurantiamaric acid* occurs in several species of *Citrus*...

SIMARUBACEAE. Ailanthus Family

Trees or shrubs with bitter bark; leaves pinnate, alternate, without punctate dots; stipules minute or none; flowers in axillary panicles or racemose clusters; regular, dioecious or polygamous; calyx 3-5 lobed; petals 3-5; stamens of the same number as the petals or twice as many; pistils 2-5 and 1-5 celled; disk elongated or annular.

A small family of 125 species of warm or tropical regions. The most widely known member of the family in the United States is the tree-of-Heaven or Chinese sumac (*Ailanthus glandulosus*). The quassia(*Q. amara*) of Guiana is used in fevers and as a substitute for hops to impart bitter flavor to beer. It contains *quassin* $C_{32}H_{40}O_{10}$ a bitter principle. The bark of other plants of the order is bitter, like the *simaruba* bark. The cedron (*Simaba Cedron*) of Central America is used in the tropics for snake bites. The bitter fruit of *Simaba valdivia* contain a gulcoside $C_{18}H_{24}O_{10}$.

Ailanthus Desf.

Large trees; leaves compound, odd-pinnate; flowers in panicles, greenish white; calyx short, 5-cleft; 5 spreading petals; disk 10-lobed; 10 stamens of the staminate flowers inserted at the base of the disk; ovary of the pistillate flowers deeply 2-5 cleft, 1-celled; stamens 2-3; winged fruits 2-5. Three species native of China and Eastern Asia.

Ailanthus glandulosus Desf. Tree-of-Heaven

A tall tree with ample leaves, smooth or slightly pubescent; 13-41 stalked leaflets; ovate or ovate-lanceolate flowers, greenish pedicelled, the staminate ones badly scented.

Distribution. Commonly escaped from cultivation, along roadsides from Southern Ontario to Kansas, Southeast Iowa, hardy as far north as Central Iowa.

Poisonous properties. The bark is known to be poisonous. Dr. White, in his Dermatitis Venenata states that he read an account in some medical journal of the suspected poisoning by this tree during its flowering season, and the statement was made that a case of marked dermatitis of the face, had been attributed to the emanations of a tree of this species, growing very near the sleeping-chamber of the patient. He records a case where a lady was poisoned by contact with it. Dr. Halsted states that when the flowers are handled they produce an irritation of the skin.

In the Medical and Surgical Reporter of Philadelphia for 1872, this statement is quoted by Dr. Rusby in regard to the poisoning coming from the roots of this plant.

> A case in which four persons were apparently poisoned by this root. They were members of one family and were successively, that is, at intervals of a few days, attacked, with no other possible cause than their drinking water which they took from the well of a neighbor. They all drank water exclusively, except the husband, who was the last to be taken. Others who drank of this water occasionally suffered similarly but to a slight extent. All immediately began to recover as soon as the drinking of this water was stopped. The symptoms, which had been slight for many weeks, appeared in a violent form in November, at which time an Ailanthus tree growing in the vicinity of the well must have shed its leaves, and to a great extent its fruit also, if a pistillate tree, which fact was not stated. On examination the soil all about the well was found to be thickly permeated with the roots of this tree, and these were also supposed to extend into the water, though an investigation regarding this was apparently not made. Inasmuch as the symptoms had existed in a mild form before the fall of the leaves, it is fair to assume that the roots had contributed toward the result, while the violent out-break in November would seem to indicate a sudden increase in the cause due to the accumulation of the leaves in the well. The symptoms were jaundice, a dingy aspect of the face and eyes, countenance fixed and anxious, pulse frequent and soft, yellowish fur on tongue, except on the tip and edges, tenderness over the liver, and most important, a persistent pain over the stomach with paroxysmal vomiting, pain in the back, difficult urination and obstinate constipation. The symptoms were thus apparently to a great extent those of chronic gastritis.

Dr. Schaffner says that cows will not eat grass near the young shoots. *Quercetiin* occurs in the leaves. They also contain the bitter principle *linuttin.*

POLYGALACEAE. Milkwort Family

Herbs or rarely shrubs; stipules none; flowers perfect; sepals 5; petals 3 or 5, free; stamens 4-8, monadelphous, or diadelphous; anthers 1-celled, open-

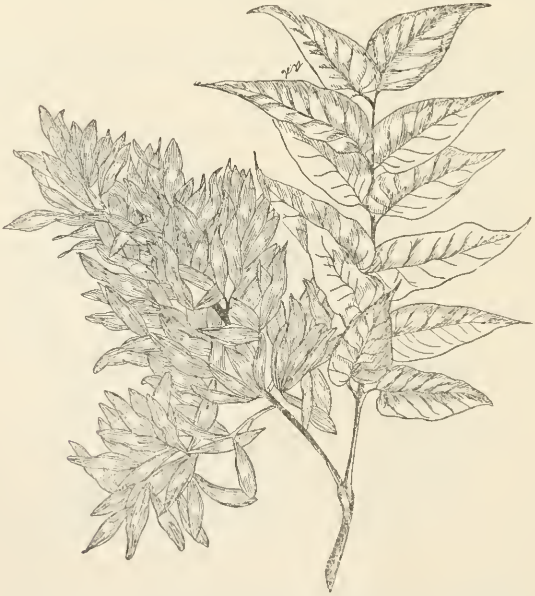

Fig. 322. Tree of Heaven (*Ailanthus glandulosus*). The bark is supposed to cause dermatitis. (Ada Hayden).

ing at the top by a pore; ovary 2-celled; ovules 2; fruit a 2-seeded pod. A small order of about 700 species, found chiefly in the tropical and temperate regions. Some species of the order produce a strong fiber.

Polygala (Tourn.) L. Milkwort

Herbs or shrubs; simple entire, dotted leaves without stipules; flowers perfect, irregular, occasionally cleistogamous; calyx of 5 sepals, the 2 lateral known as wings, large, colored, the other small, greenish; petals 3, free, connected with each other and the stamen tube; stamens 6 or 8, filaments united below or in 2 sets; pistil 1; ovary 2-celled; ovules 1 in each cell; fruit mainly capsular; seeds with a caruncle, anatropous; embryo large; little endosperm. About 250 species, of wide distribution, chiefly of warm regions. A genus of little economic importance.

Polygala Senega L. Seneca Snakeroot

Plants clustered, several from a woody and knotty rootstock, simple 6-12 inches high; leaves lanceolate or oblong-lanceolate with rough margins; dense spike, long peduncle; flowers white, none cleistogamous; wings round-obovate; crest short; seeds hairy.

Distribution. In rocky woods or clay soil. New Brunswick to Minnesota, Central Iowa to the Rockies in Canada.

Poisonous properties. The dried root is gathered when the leaves are dead,

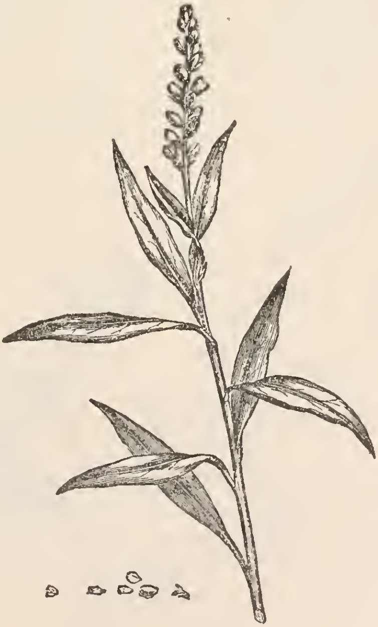

Fig. 323. Seneca Snakeroot (*Polygala Senega*). Dried root is made into a powder which is very acrid. (From Johnson's Med. Bot. of N. A.).

and made into a powder and a tincture prepared. This tincture has a peculiar acridity. Dr. Millspaugh says:

> After tasting the tincture or chewing the rootlets, a very peculiar sensation of acridity and enlargement is felt at the root of the tongue, which, once recognized, will always mentally associate itself with this plant. The root contains polygalic acid $C_{22}H_{18}O_{11}$. It is a white, odorless, acrid, amorphous powder.

This acid forms a frothing, saponaceous solution in boiling water, and breaks up into *sapogenin* and amorphous sugar, to which the name *senegin* has been given, which by some has been regarded as identical with *saponin.* According to the author quoted above, in doses of 10 minims of the tincture to a scruple of the powdered root, it produces:

> Anxiousness, with dullness of the head and vertigo; aching and weakness of the eyes, with lachrymation, pressure in the ball, flickerings, dazzling vision, and contracted pupils; sneezing; ptyalism; inflammation of the fauces and oesophagus, with thirst with anorexia; nausea; mucous vomiting; burning in the stomach; cutting colic; roughness and irritation of the larynx, with orgasm of blood to the chest, accompanied by constriction, aching, soreness, and oppression; general debility; restless sleep; and profuse diaphoresis.

Senegin resembles other *saponins.* Recent investigations indicate that the plant also contains *quillagic acid* $C_{19}H_{30}O_{10}$ *sapotoxin* and two senega *saponins.* The *saponin* of *Polygala virginiana* has the formula $C_{32}H_{52}O_{17}$. Other species of *Polygalaceae* like *P. venenosa* contain *saponin.*.

EUPHORBIACEAE. Spurge Family

Herbs, shrubs or trees usually with a milky acrid juice, opposite alternate or verticillate leaves; monoecious or dioecious flowers, much reduced, subtended by bracts resembling a calyx or corolla; ovary usually 3-celled; ovules 2 in each cell, pendulous; stigmas as many or twice as many as the cells; styles generally 3; fruit a capsule, separating elastically into a 2-valved capsule; fleshy or oily endosperm; seeds with flat cotyledons.

A large family of 4000 species, chiefly tropical, many of which possess noxious qualities. Some species of the genus *Manihot* found in tropical Amer-

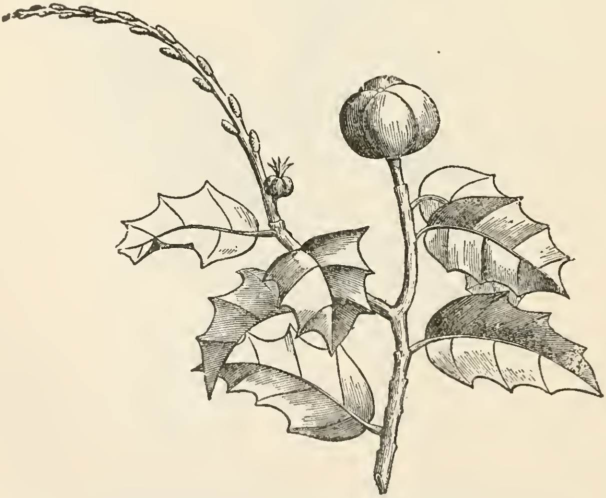

Fig. 324. Manchineal Tree (*Hippomane Mancinella*). Furnishes an arrow poison. (From Vesques' Traité de Botanique).

ica are poisonous. The fresh juice of bitter cassava administered to dogs and cats causes death in twenty minutes. The starch from this is used for sizing. Cassava (*Manihot utilissima*) is extensively cultivated in tropical America and to some extent also in Florida. The sweet cassava roots are used as food for cattle and man. Tapioca is the starch which settling from the water used to wash cassava meal, is afterward dried. An intoxicating drink is made from cassava bread. Rubber plants of the order are the *Hevea, Micrandus* and *Manihot.* The manchineal tree (*Hippomane Mancinella*), the celebrated poison tree of tropical America furnishes an arrow poison. The fruit, though tempting, contains an acrid poison, which causes blisters to form. The poisonous properties are said to rival those of the deadly Upas tree (*Antiaris toxicaria*).

The following is an extract from "West India Sketches":

> The branches contain a milky juice which will certainly blister the skin ,and it has been a common trick among the negroes to apply it to their backs in order to excite the compassion of those who might mistake it for the effects of beating.

Kingsley, in his charming "At Last," writes of it:

> We learnt to distinguish the poisonous manchineal, and were thankful in serious earnest that we had happily plucked none the night before, when we were snatching at every new leaf; for its milky juice by mere dropping on the skin burns like the poisoned tunic of Nessus, and will even, when the head is injured by it, cause blindness and death.

Dr. White in his Dermatitis Venenata, speaks of the use of the plant in the West Indies as follows:

> This large family of *Euphorbiaceae* contains some of the most poisonous plants. One of the most virulent is the manchineal, a small tree, bearing fruit resembling an apple, which grows in Southern Florida.

Loudon states that it abounds in a white milk which is highly poisonous, and so very caustic that a single drop placed upon the skin instantly causes the sensation of a hot iron, and in a short space of time raises a blister. It is a common belief that to sleep under it causes death. Whole woods on the seacoast of Martinique have been burned in order to clear the country of such a dangerous pest. The fruit is highly poisonous.

Mr. Combs in his paper on Cuban Medical plants, states that its poisonous effects may be overcome by the use of *Tecoma leucoxylon* or *Jatropha gossypifolia.* The uncooked rhizome of *Maranta arundinaceae* is sometimes used for the same purpose. The latex of the sandbox tree *Hura crepitans* is also very poisonous and when applied to the skin, causes eruptive pustules resembling those of erysipelas. It also produces injuries to the eyes. It contains a sharp acrid poison. When taken internally it produces vomiting and diarrhoea. The seeds are used as emetic.

The Nigeria species of Mahogany (*Ricinodendron africanus*) also produces a valuable wood.

The tallow tree (*Sapium sebiferum*) is cultivated in tropical countries for wax found on the fruit, which is made into candles.. The candlenut tree (*Aleurites triloba*) is cultivated on the islands of the Pacific Ocean for oil found in the seeds, which is made into candles, soap, etc. The seeds of *A. moluccana* are roasted and eaten. The Kalo Nut (*A. Fordii*) according to Holmes * is poisonous having produced toxic symptoms in five children. It is the source of tung or Chinese wood oil. The seeds of pinhoen oil (*Jatropha Curcas*) are eaten. They are nutty and have a pleasant flavor, but when eaten in excess, produce serious trouble and death often results. The drastic principle of Croton

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* Pharm. Jour. 4:25, 231, 241. Brit. Yearbook of Pharm. 1908:240.

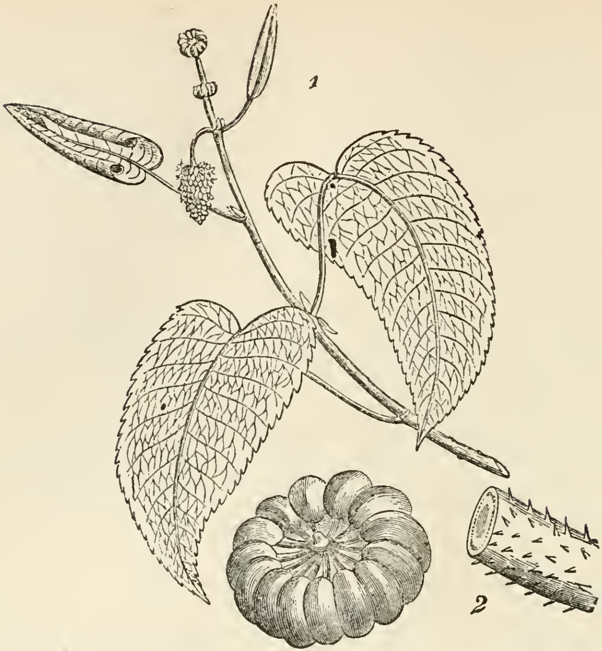

Fig. 325. Sandbox Tree (*Hura crepitans*). 1. Flowering and fruiting branch. 2. Part of a large branch. Latex causes dermatitis. (From Vesque's Traité de Botanique.)

oil (*Croton Tiglium*) has not been definitely determined, but it has been refined to a dark brown oil known as *crotonol*. The plant contains *tiglinic acid* $C_5H_8O_2$. Crotinic acid $C_4H_6O_2$ and Croton oil are derived from the *Croton Tiglium*, that is cultivated in southern India. This plant is a drastic purgative, capable, when given in excessive doses, of causing death. The resin produces vesication. The seeds, according to Blyth, are very poisonous. The fixed oil has the formula $C_9H_{14}O_2$.

The bark of Cascarilla (*Croton Eluteria*), native to the Bahamas, is used as a tonic and contains *cascarillin* $C_6H_9O_2$. The milky juice of *Euphorbia resinifera* of Morocco is used as a purgative and is so intensely acrid that people in collecting it are compelled to tie a cloth over their nostrils and mouths. It contains the substance *euphorbon* $C_{27}H_{44}O_7$, which has a burning taste. The milky juice of agallocha (*Excoecaria Agallocha*) of tropical Asia is very acrid and blisters the skin. It is said that if the juice drops into the eye as sometimes happens to the woodcutter, blindness may be caused. *Excoecaria glandulosa* contains *excoecarin* $C_{13}H_{12}O_5$. The *Homalanthus Leschenaultianus* is said to be poisonous. The fruit of Hyaena poison (*Toxicodendron capense*) of South Africa is very poisonous, and is used to destroy beasts of prey. Gum elastic or Para rubber is derived from the South American *Hevea brasiliensis.* Other plants of the family yield caoutchouc, which contains hydrocarbons that are readily soluble in chloroform. The alkaloid *drumin* occurs in *Euphorbia Drummondii*. Several species of Euphorbia like Poinsettia (*Euphorbia splendens*) and *E. heterophylla* are cultivated for ornamental purposes. From the

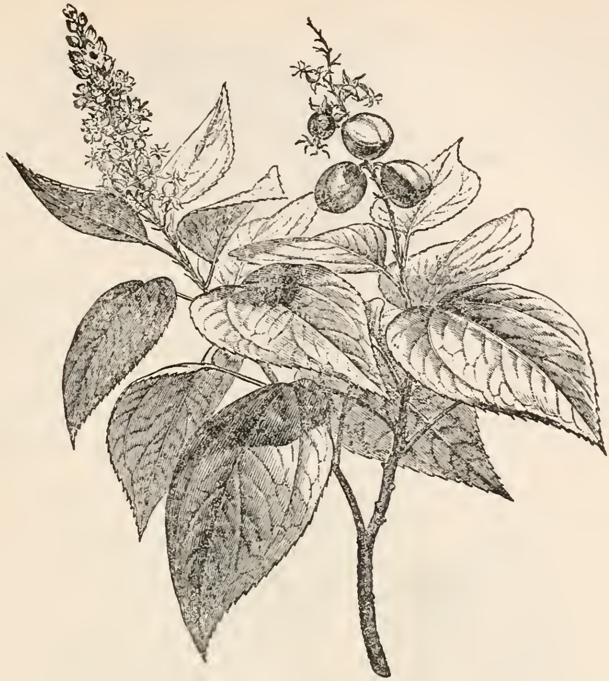

Fig. 326. Croton (*Croton Tiglium*). Flowering and fruiting branch. The source of croton oil. (After Faguet.)

glands and hairs covering the fruit of kamala (*Mallotus philippinensis*) a dye is made. The fruit is also used as a vermifuge; it contains *rottlerin* $C_{22}H_{20}O_6$ and *isorottlerin*. Many species of the genus are regarded as poisonous. Maiden states that the *E. Drummondii* is poisonous to stock in New South Wales. It is known as the milk plant and is especially troublesome to sheep. It causes the head to swell to an enormous size so that the animal cannot support its head. Suppuration frequently follows. *E. alsinaeflora* is also poisonous to sheep in the same country. *E. eremophila* is another suspect in that country. *E. heptagona* is an arrow poison. Some species of this genus are used as fish poisons. Emanations of *E. characias* at one time were supposed to cause malarial fever which, however, was an erroneous assumption. Lehmann, a German writer on poisonous plants lists the following species as poisonous: *E. Lathyris, E. Heliscopia, E. platyphylla, E. Esula, E. Cyparissias, E. palustris, E. Peplus, E. exigua.* The *E. antiquorum* of the East Indies, *E. canariensis* of the Canary Islands, and *E. Reinhardtii* of the Transvaal contain a milky acrid poisonous juice.* The resin from *Euphorbia* produces sneezing, irritation of face and skin, vomiting and diarrhoea and when used in large doses, death. Where the drug is manufactured, workmen must protect themselves; but, even then, headache, dizziness and weakness follow. To poisoning from members of the genus *Euphorbia,* Friedberger and Fröhner ascribe such symptoms as constipation, severe and bloody diarrhoea, feeble pulse and tympanites.

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* Bull. Misc. Inf. Roy. Gard. Kew, 1908: 154.

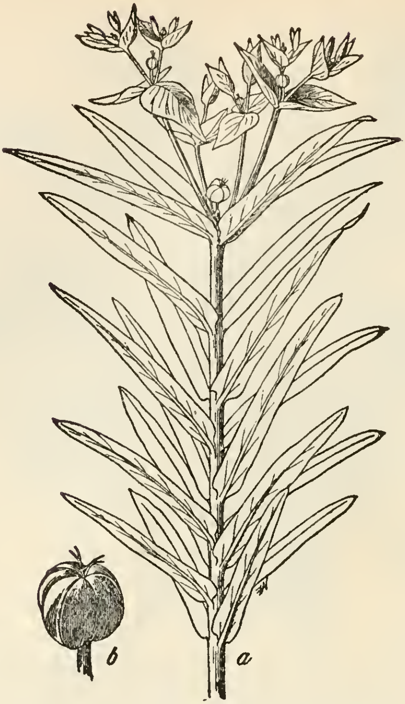

Fig. 326. Caper spurge (*Euphorbia Lathyris*). a, upper half of plant, one-third natural size; b, seed capsule, natural size. Listed by Lehmann as poisonous. (Chesnut, U. S. Dept. Agr.)

According to Greshoff the leaves of *Andrachne cordifolia* and other members of the family contain hydrocyanic acid.

Key for genera of Euphorbiaceae:

Flowers without a calyx inclosed in a cup-shaped involucre. 5. *Euphorbia.*
  Flowers with a calyx; involucre absent.
    Flowers apetalous in panicles; stamens 10.
      Calyx corolla-like; plant with stinging hairs. 4. *Jatropha.*
    Flowers in terminal racemes or spikes covered with scurfy or stellate hairs, glandular.
      Flowers spiked or glomerate; ovary usually 3-celled. 1. *Croton.*
    Flowers in axillary spikes or paniculate; stamens 8 or more.
      Fertile flowers in the axils of leafy bracts; stamens usually 8. 7. *Acalypha.*
      Flowers in interrupted axillary spikes; stamens 8-20. 6. *Mercurialis.*
      Flowers paniculate; stamens very numerous; filaments branched. 3. *Ricinus.*
    Flowers apetalous in racemes or spikes; stamens 2 or 3 style simple.
      Flowers racemose, hirsute or pubescent. 2. *Tragia.*
      Flowers spicate, glabroid. 8. *Stillingia.*

1. *Croton* L.

Stellate, pubescent herbs or shrubs; leaves generally alternate, occasionally with glands at the base of the blade; flowers spicate or racemose, the staminate above; calyx 4-6 parted; petals usually present, small or rudimentary, alternating with the glands; stamens 5 or more; pistillate flowers with calyx 5-10 parted; petals usually wanting; ovary mostly 3-celled, with a single ovule in each cell.

Croton capitatus Michx. Hogwort

An annual, dense, soft woolly herb, somewhat glandular, from 1-2 feet high, occasionally branched; leaves entire, lanceolate oblong, with long petioles; sterile flowers with 5-parted calyx and as many glands alternating with the obovate lanceolate petals which are fimbriate; fertile flowers several, capitate or crowned; calyx 7-12 parted; 5 petals wanting; styles twice or thrice forked; seeds gray, smooth.

Distribution. A common weedy plant from Missouri to Texas; from New Jersey to Georgia, Iowa and eastern Kansas.

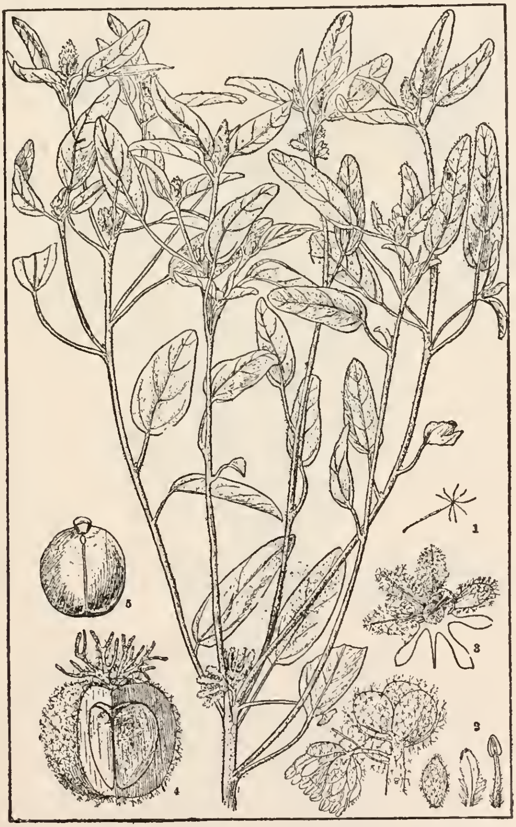

Fig. 327. Hogwort (*Croton capitatus*). Suspected of being poisonous. (After A. M. Fergusonn, Rep. Mo. Bot. Garden)

Croton texensis Muell

A branching annual from 1-2 feet high, covered with close stellate pubescence; leaves narrowly oblong-lanceolate to linear; dioecious; calyx lobes 5, unequal; petals none; staminate spikes short; stamens 10 or more; style 2 or 3 times dichotomously 2-parted; capsule stellate, tomentose and roughened; seeds ovoid or oval.

Distribution. From South Dakota to Colorado, Texas, Mexico, Missouri and Alabama.

Poisonous properties. Several species of the genus *Croton* are used in medicine. The *Croton Tiglium* contains an oil which given internally is a powerful cathartic, but when applied externally, is a rubefacient. Loss of the hair follicles and of hair may occur. When gently rubbed into the skin, it produces, after a short time, a considerable degree of itching, redness, and burning, and within a few hours small red papules may develop. If more of the oil is applied the papules are more abundant and are often surrounded with a bright red halo. They often become pustular and scars fill the pustules.

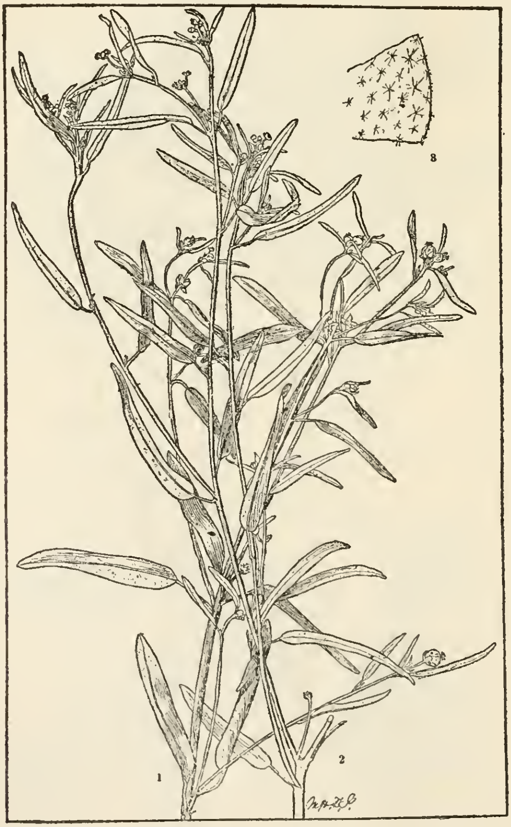

Fig. 328. Texas Croton (*Croton texensis*). Sometimes causes irritation of the skin. (After Mrs. M. H. D. Irish, Rep. Mo. Bot. Garden.)

Croton oil contains several fatty acids, such as stearic, palmitic, myristic and lauric acids. The volatile part of the acids contains an acid called *tiglinic* $C_5H_8O_2$, which is the same as *angelic acid.* The drastic principle of Croton oil has not been definitely determined, according to Flückiger and Hanbury. *Crotonol* $C_{18}H_{24}O_4$, is a non-purgative body causing irritation of the skin. According to Winslow, in his Veterinary Materia Medica and Therapeutics, "10 drops of croton oil will kill a dog unless vomiting occurs. 30 drops prove fatal to a horse, intravenously. The treatment of poisoning includes the use of emetics or stomach tube, demulcents and opium." None of our native species is mentioned as poisonous by Dr. Schaffner or Prof. Chesnut, but a few years ago I had a query through the *Wallace Farmer* in Des Moines, from a correspondent in Western Nebraska who suspected that the Texas croton was poisonous. The writer has eaten a few seeds of our southern *Croton capitatus* with slight uneasiness. On the other hand, a few seeds of the Texas croton produced powerful irritation which lasted for an hour, and then disappeared. It is listed by Bessey and O'Gara as possibly poisonous in Western Nebraska. Prof. Chesnut states in his paper on Plants used by the Indians in Mendocino county, California, that the bruised leaves of *Croton setigera* are used to stupefy fish. The common name, fish soap-root, indicates its use.

The bark of the cascarilla (*Croton Eluteria*), native of the Bahama Islands is used as a tonic.

Tragia L. Tragia

Monecious herbs or shrubs, usually armed with stinging hairs; leaves alternate; flowers in racemes with bractlets, apetalous; sterile flowers with a 3-5 cleft calyx; fertile flowers with a 3-8-parted calyx, divisions entire or pinnati-

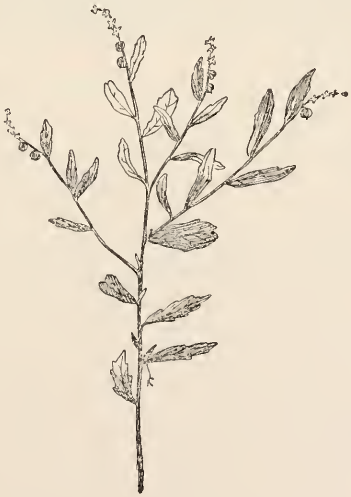

Fig. 329. Spurge Nettle (*Tragia urens*). This spurge is common in some places in the South and has hairs that are irritating like those of the common nettle. (Charlotte M. King.)

fid; styles 3; capsule 3-lobed, separating into three 2-valved carpels. A small genus of 50 species.

Tragia urens L. Common Nettle or Tragia

A dull green, pilose plant with pilose or hirsute hairs; erect, branched stems; leaves obovate, or ovate-linear; short, petioled, pistillate flowers, several at the base of the racemes, with a 5-6 lobed calyx; capsule short-pedicelled.

Distribution. From Virginia to Florida and Texas.

Tragia nepetaefolia Cav. Tragia or Nettle.

A somewhat hispid, erect, or slightly twining plant, bearing stinging hairs; leaves ovate, or triangular-lanceolate; base cordate or truncate; short petioled; racemes many-flowered; pistillate flowers with a 5-lobed calyx; seeds chestnut brown.

Distribution. From Kansas to New Mexico.

Poisonous properties. The hairs have the same stinging property as those of the common nettle.

3. *Ricinus* (Tourn.) L. Castor Oil Bean

A tall, stout herb or tree in tropics; glabrous and glaucus; large, alternate, peltate leaves; flowers in large, panicled clusters; the fertile above, the staminate below; calyx 5-parted; stamens numerous; styles 3, united at the base, each 2 parted, red;capsule subglobose, or oval, separating into 3, 2-valved carpels; cotyledons large; endosperm fleshy and oily. A single species naturalized in warm countries, probably native to Asia.

Ricinus communis L. Castor Oil Plant

A tall, smooth, branching herb with palmately-lobed leaves; seeds oblong, shining, variegated with white.

Distribution. Widely cultivated as an ornamental plant, and an escape from cultivation from New Jersey to Texas.

Poisonous properties. The seeds furnish the well known castor oil, which is a mild and safe purgative. It contains *ricinolein,* or *ricinoleic acid glycerid,* C_3H_5 $(C_{18}H_{34}O_3)_3$; an acrid principle; also *palmitin, stearin,* and *myristin.* The purgative principle found in it is unknown. Castor oil is not poisonous, but the pulp contains an acrid, albuminous substance, *ricin* $C_8H_8N_2O_2$. Dr. Winslow, in speaking of the poisonous character, says, the seeds "contain 50 percent of oil, and an acrid, poisonous substance. Three seeds have caused death in man,, and they are ten times more purgative than the oil." A few seeds eaten entire by a child might produce serious symptoms. According to Chesnut, the seed eaten accidentally by horses has caused death. They are used also to poison sheep, according to the same authority. The oil cake is said not to be poisonous to poultry and cattle. A case is known of a young lady whose eyes became inflamed when in contact with a mere trace of the material in the laboratory. The toxin is very poisonous, but animals may be rendered immune, and the seeds then fed to them. Behring has produced an anti-toxic serum against the *ricin* or toxin of the castor oil bean.

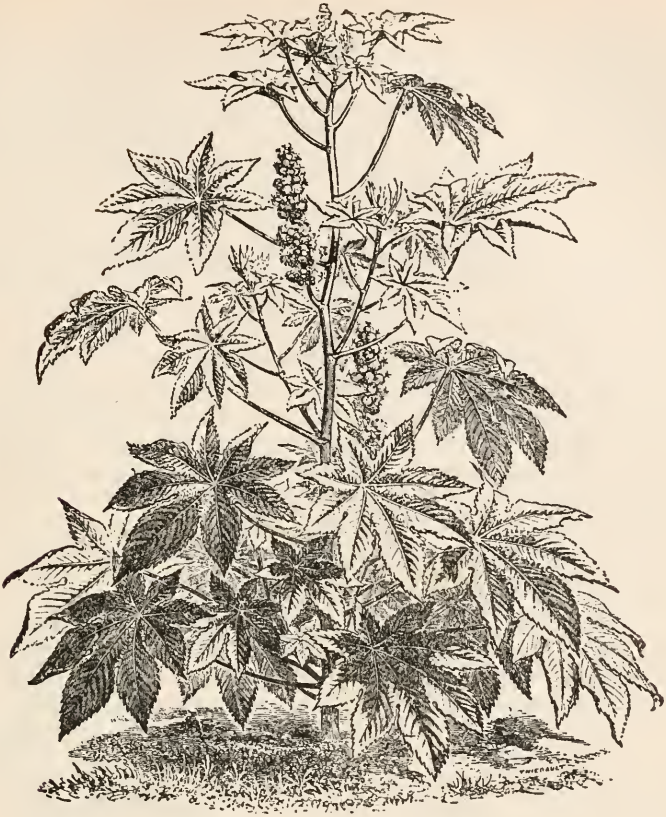

Fig. 330. Castor Oil Plant (*Ricinus communis*). Furnishes the well known castor oil of commerce. (After Faguet.)

The symptoms of poisoning are vomiting, gastric pain, bloody diarrhoea and dullness of vision.

Stillmark[1] states that the toxalbumin of castor oil bean, when injected into the circulation is more poisonous than strychnin, prussic acid, or arsenic.

Quite recently Dr. W. N. Bispham[2] reported on several cases of poisoning in Cuba from eating the seeds of the Castor oil plant. Some persons showed peculiar susceptibility; in one case poisoning occured from eating a single seed, while in another a good many were eaten; in both cases the seeds caused nausea, vomiting, and purging of a violent nature.

Toxic substances similar to *ricin* occur in the following plants. *Abrus precatorius* (*abrin*), *Jatropha curcas* (*curcin*), *Croton Eluteria* (*crotin*), *Robinia Pseudo-Acacia* (*robin*), *Brayera anthelmintica* (*costoxin*). According to Ceni and Besta a toxin also occurs in *Urtica, Viscum* seedlings, *Aspergillus flavus,* and *A. fumigatus.*

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[1] Dorpat. Arch. 3: (1889).

[2] Am. Jour. Med. Sci. 126: 319-321.

4. *Jatropha* L. Spurge Nettle or Bull Nettle

Monoecious, or rarely dioecious, perennial herbs, with bristly hairs, entire or lobed leaves; flowers in cymes; calyx colored like petals in sterile flower, mostly salver-shaped, and 5-lobed, enclosing 10-30 stamens; pistillate flowers in the lower forks of the cymes; capsule ovoid or subglobose, separating into 2-valved carpels. A small genus of 4 or 5 species.

Jatropha stimulosa Michx

A branching, perennial plant with a stout root, 6-12 inches high, and stinging hairs; leaves round, heart-shaped, 3-5 lobed or variously cleft; calyx of the staminate flower salver-form, white or pinkish; stamens 10, filaments almost separate; seeds oblong-ovoid, smooth and mottled.

Distribution. In dry sandy soil from Virginia to Texas.

Poisonous properties. Mr. John Smith says that a plant growing at Kew was placed on his wrist, and produced in a few minutes, serious symptoms extending to the upper part of his body; the lips became swollen, and the whole of a livid red, fainting coming on in ten minutes. The writer was told of numerous instances of poisoning in Texas where it is much dreaded.

Jatropha urens, known as the Brazilian stinging nut, is considered to be one of the most poisonous plants known. The Cuban physic nut (*Japtropha Curcas*) is used as a purgative.

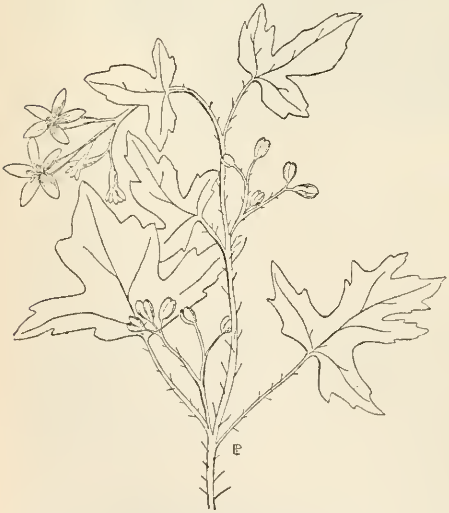

Fig. 331. Spurge Nettle. Lois Pammel.

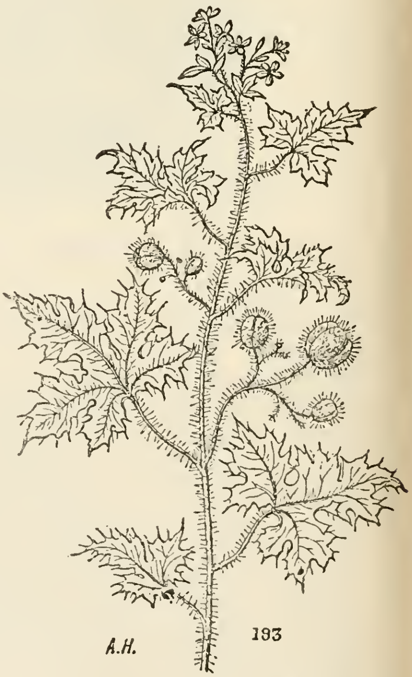

Fig. 332. Spurge nettle (*Jatropha stimulosa*). The Jatropha has stinging hairs that produce injuries similar to those produced by nettle but much more powerful. (After Hochstein).

5. *Euphborbia* L. Spurge

Monoecious shrubs or herbs with alternate or opposite, verticillate leaves; flowers involucrate, involucres resembling a calyx or corolla, bearing a large thick gland in the sinuses; staminate flowers consist of a single jointed stamen on a filament-like pedicel; pistillate flower solitary at the bottom of the involucre consisting of a 3-lobed and 3-celled ovary; capsule at maturity breaking into 3-lobed 1-seeded carpels; seeds frequently caruncled, smooth, variously pitted. About 700 species, chiefly in warmer regions. A few are weedy, some poisonous and some planted for ornamental purposes. The milky juice of the Brazilian *E. heterodoxa* produces a ferment which acts much like *papain.*

Euphorbia Presilii Guss. Large Spotted Spurge

An ascending, erect annual from 1-2 feet high, opposite oblique leaves, which are ovate, oblong or oblong-linear, falcate, serrate, usually with a red spot or red margins; stipules triangular; flowers collected in a loose terminal cyme; appendages entire, white or red; pod smooth, angled; seeds small, blackish, ovate, obtusely angled, wrinkled, and tubercled.

Distribution. Common in eastern North America west to the Rocky Mountains.

Euphorbia maculata L. Spotted Spurge

A prostrate spreading, hairy annual; leaves oblong-linear, pubescent or smooth, oblique at base, serrate above, small brownish spots on leaves; stipules lanceolate, fimbriate; flowers monoecious, included in a 4-5-lobed involucre; glands of the involucre minute; peduncles as long as the petioles, in dense clusters; pods minutely pubescent; seeds sharply 4-angled, having 4 shallow grooves, whitish.

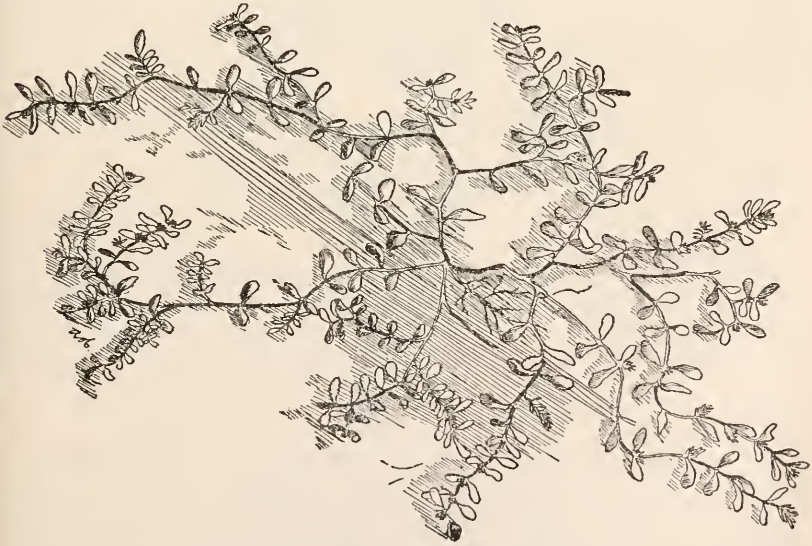

Fig. 333. Spotted Spurge (*Euphorbia maculata*). Common roadside plant. Probably poisonous. (C. M. King).

Distribution. Common along roadsides, walks, etc., from New England to the Rocky Mountains and the Gulf States.

Euphorbia marginata Pursh. Snow on the Mountain

An erect, stout annual from 2-3 feet high; stem hairy or somewhat smooth; leaves sessile, scattered, ovate or oblong, entire; deciduous stipules; uppermost leaves opposite or whorled with conspicuous white petal-like margins; involucre bell-shaped in umbels; glands of the 5-lobed involucre with broad and white appendages; seeds ovoid, globose, terete, dark ash colored, reticulate.

Distribution. Frequently cultivated in gardens from whence it has escaped. Found in Ohio, Illinois and Indiana. Native from western Minnesota, Iowa to Colorado, and Texas.

Euphorbia corollata L. Milkweed or Flowering Spurge

Perennial with a long, stout rootstock, glabrous or sparingly hairy; leaves ovate, lanceolate, or linear, obtuse, short-petioled, or sessile; inflorescence in umbel-like clusters; involucre long peduncled with white conspicuous appendages; seeds thick, ovoid, slightly pitted, ash-colored.

Distribution. In rocky or sandy soil, Mass. to New York, New Jersey, Florida, Wisconsin, Minnesota, and Texas.

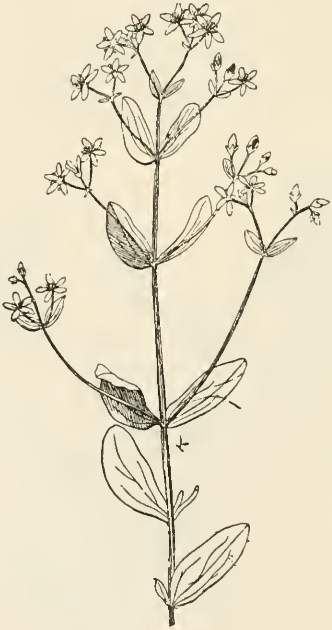

Fig. 334. Common Flowering Spurge (*Euphorbia corollata*). A plant with milky juice which has irritating properties. common in sandy fields. It has white bracts resembling flowers. (Charlotte M. King.)

Euphorbia Lathyris L. Myrtle Spurge

A glabrous annual or biennial, simple below, branched above, from 2-3 feet high; leaves thick, linear or oblong, scattered, the upper lanceolate or linear-lanceolate; inflorescence umbel-like, bearing 4 crescent-shaped glands, prolonged into horns; seeds oblong-ovoid, terete, usually wrinkled.

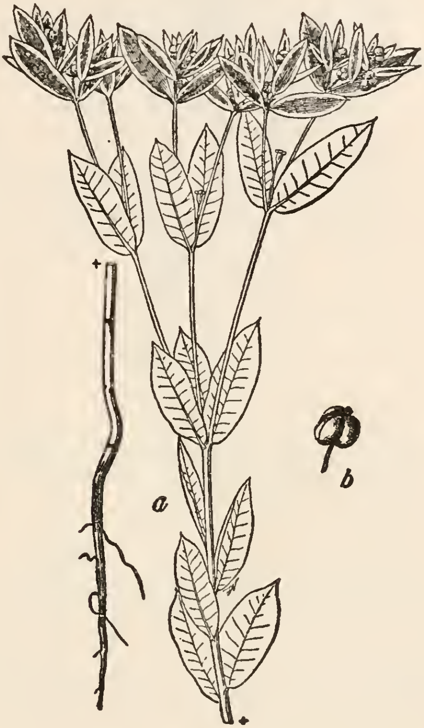

Fig. 335. Snow on the mountain (*Euphorbia marginata*): a, whole plant, one-third natural size; b, seed capsule, natural size. Cultivated in old gardens. (Chesnut, U. S. Dept. Agr.)

Distribution. In waste places. New Jersey to North Carolina, Iowa, and California. Native to Europe.

Euphorbia Ipecacuanhae L. Wild Ipecac

Perennial from 5-10 inches high; long perpendicular root; entire, smooth leaves, varying from obovate or oblong to narrowly linear, nearly sessile; involucres long peduncled and 5 transversely elliptical or oblong green glands; seeds smooth, ovate, white, pitted, and obscurely 4-sided.

Distribution. In sandy soil from Connecticut to Indiana and Florida.

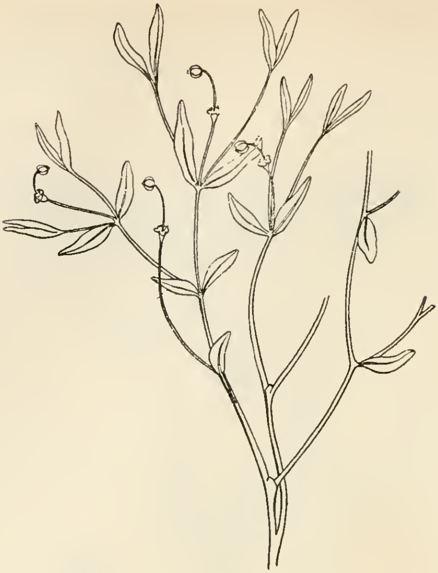

Fig. 336. Wild Ipecac (*Euphorbia Ipecacuanhae.*) Plant that possesses irritating properties and is also a purgative. (Millspaugh and Charlotte M. King.)

Euphorbia heterophylla L. Cruel Plant

An erect, smooth annual from 1-3 feet high; leaves alternate, petioled, linear lanceolate to orbicular, undulate, entire or toothed; the upper leaves usually fiddle-shaped, with a red base; involucre in terminal clusters, 5-lobed, with a single or a few almost sessile glands; seeds nearly round, transversely wrinkled and tubercled.

Distribution. From Illinois and Missouri to Nebraska.

Euphorbia Cyparissias L. Cypress Spurge

A bright green perennial from 6-12 inches high with running rootstocks; stems clustered, occurring in patches; stem leaves linear, entire, densely crowded, those of the flower heart-shaped and entire; flowers in umbellate clusters, umbel many-rayed, glands crescent-shaped; pods granular; seeds oblong and smooth.

Distribution. Native to Europe, but widely scattered in eastern North America. First introduced as a cultivated plant in North America.

Poisonous properties. All of the species are more or less irritating and in drying give off very disagreeable odors. Many of the species of the genus are used by quacks to remove warts and freckles; the juice produces an erysipelatous-like inflammation, and in one case mentioned by Dr. White, the whole abdominal wall became gangrenous.

The milky juice of the plant causes itching and inflammation. The general effect is very much like that of poisoning from the poison ivy. In Texas, according to Chesnut, the juice of *E. marginata* is used to brand cattle. The honey

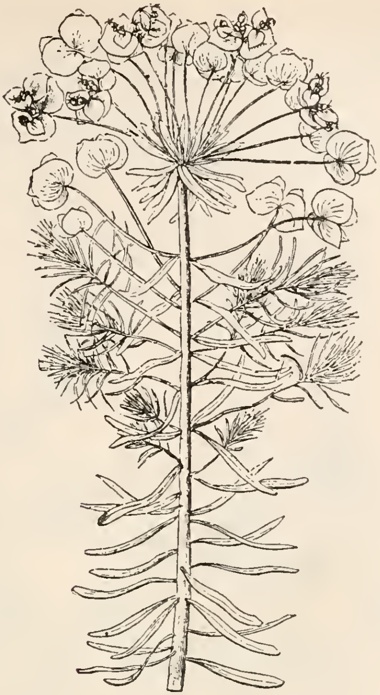

Fig. 337. Yellow Flowering or Cypress Spurge (*Euphorbia Cyparissias*). A branch with large bracts and small flowers. (Strasburger, Noll, Schenck and Schimper.)

obtained by bees from the plant is poisonous and is rendered unfit for use. The acrid properties of this species were described some years ago by Dr. Schneck. The juice of *E. corollata,* according to Dr. Halsted and many other observers, is acrid, and, on the authority of Dr. Bigelow, formerly was used for blistering purposes. The bruised root will vesicate the skin. According to Dr. J. C. White, the dust of this species produces painful swelling and vesicles upon men who handle the plant. It is used as an emetic, and is troublesome to those who collect it.

The *Euphorbia pilulifera* is used as a sedative in spasmodic conditions of the respiratory apparatus. It produces dermatitis. Dr. White, in his Dermatitis Venenata, has this to say of the species of the genus:

> More than one hundred species of *Euphorbia,* or spurge, grow in the United States, either indigenous or immigrants from Europe. Of every species Loudon says the juice is so acrid as to corrode and ulcerate the body wherever applied; and of *E. resinifera,* from which the official *euphorbium* is obtained, Pliny and Dioscorides, according to the Dispensatory, describe the method of collecting juice, so as to prevent irritation of the hands and face. This substance is used as a plaster to prolong suppuration.
>
> Van Hasselt states that the juice of several species is used by quacks to remove warts, freckles, as depilatory, etc.; and that the application of the juice, powder, and extract produces not only erysipelatous, pustular, and phlegmonous inflammation, but even gangrene. In one case mentioned the whole abdominal wall became the seat of gangrene.

Of our native species, Bigelow says that the juice of several was used in his day to destroy warts. and Gray describes them all as containing an acrid, poisonous juice The most active of them are *E. corollata, E. Ipecacuanhae,* and *E. Lathyris.* The first of these, commonly called snake-milk, according to Bigelow, has been used for blistering purposes, and the Dispensatory states that the bruised root will vesicate the skin.

Mr. Cheney informs me that the juice of *E. Ipecacuanhae* is quite troublesome to many who collect and handle it; and Bazin states that the dust of *E. Lathyris,* growing both in Europe and in this country, causes redness, painful swelling, and vesicles upon the workmen employed in handling it.

With reference to the poisonous nature of the juice of the several species, nothing very definite is known. *Euphorbon* $C_{29}H_{44}O_7$ has been found in *Euphorbia Ipecacuanhae.* This *euphorbon* acts as an irritant to the mucous membranes throughout the alimentary tract. The caper spurge (*Euphorbia Lathyris*) is poisonous, and the following physiological actions are described by Dr. Millspaugh:

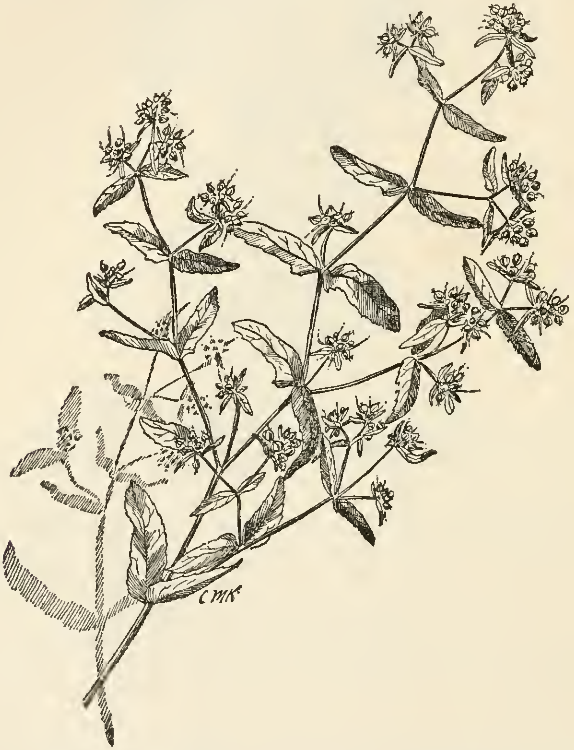

Fig. 338. Large Spotted Spurge (*Euphorbia Preslii*). Supposed to cause "slobbers" in horses. (Charlotte M. King.)

> Brilliant, staring, wide-open eyes, dilated pupils; death-like pallor of the countenance; retching and vomiting; violent purgation, stools frequent, copious, and in some cases bloody; irregular pulse; whole body cold and rigid, followed by heat and perspiration. M. M. E. Sudour and A. Caraven-Cachin state that emesis always precedes purgation, and that the seeds have an irritating action upon the mucous membrane of the intestinal canal, principally in the larger intestines. They divide the effects into three stages: *a*, the cold stage, including vomit-

ing and diarrhoea; *b*, the stage of excitation, including nervousness, vertigo, and delirium; *y*, the state of reaction, including heat and copious sweat.

With reference to the physiological action of the common spurge (*Euphorbia Preslii*), the following statement is made by Dr. True:

> Headache with frontal fullness and heat; heat about the eyes; languor and drowsiness; oppression of the stomach; and constipation. The juice applied to the eyes causes severe irritation, with smarting and burning, lachrymation, and momentary blindness; this we have experienced twice while gathering the plant. It is supposed that this species causes the affection in horses called "slobbers."

6. *Mercurialis* L. Mercury

Annual or perennial herbs; with opposite pinnately veined leaves; flowers dioecious or monoecious in interrupted axillary spikes, apetalous; calyx small, green, 3-parted; capsule 3-lobed.

Mercurialis annua L. Annual Mercury

A leafy stemmed, erect, annual herb; leaves lanceolate or ovate-lanceolate, crenate serrate; carpels hispid; indigenous to Europe, found in waste places from Nova Scotia to Ohio, and South Carolina. The *M. perennis* differs from *M. annua* in having a creeping perennial root, and hairy leaves.

Poisonous properties. Both species are acrid and poisonous.

7. *Acalypha* L. Three seeded Mercury

Herbs or shrubs, leaves alternate, petioled; flowers stipulate in spikes or spike-like racemes or solitary; calyx of staminate flowers 4-parted; calyx of

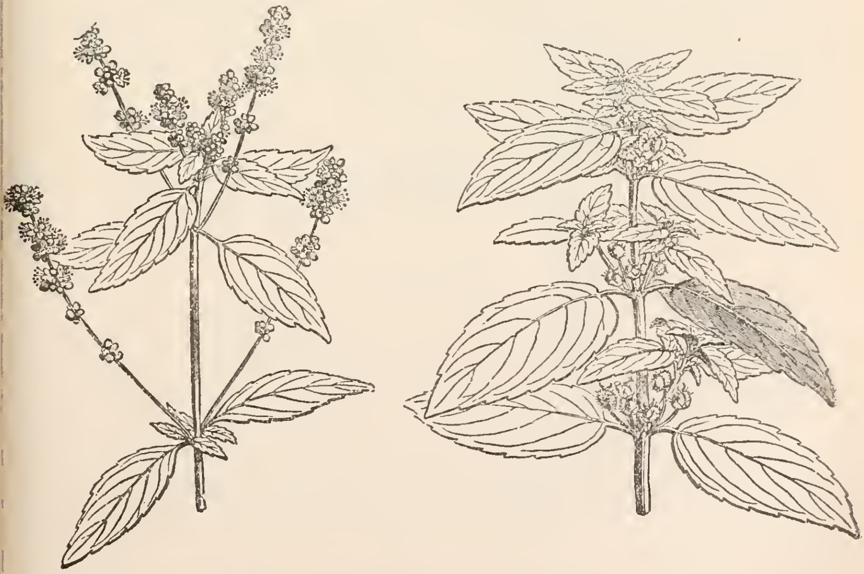

Fig. 339. Annual Mercury (*Mercurialis annua*). Staminate and pistillate branches. An acrid, poisonous plant. (After Faguet.)

the fertile flower 3-5 parted, subtended by a foliaceous bract; petals wanting in both staminate and pistillate flowers; stamens 8-16 united at their bases; capsule consisting of 3 globular 2-valved carpels, each 1-seeded. About 250 species chiefly tropical, 3 species in the central and eastern states. *A. gracilens* has smaller leaves than *A. virginica*. *A. ostryaefolia* has echinate fruit and occurs from New Jersey to Texas and Kansas.

Acalypha virginica L. Three-seeded Mercury

A smoothish or hairy annual from 1-2 feet high often turning purple, especially in the autumn; leaves ovate or oblong ovate, sparingly serrate, long petioled; sterile spike few-flowered; pistillate flowers 1-3 at the base of staminate peduncle; capsule 3-lobed subglobose; seeds ovoid, reddish striate.

Distribution. From Nova Scotia to Florida, Texas, Kansas and Minnesota.

Poisonous properties. This has been sent to me several times as supposedly poisonous. It is distasteful to cattle and they refuse to eat it in the pasture.

8. *Stillingia* L. Queen's Root

Smooth upright herbs or shrubs; leaves alternate or rarely opposite, frequently with 2 glands at the base; flowers in spikes, apetalous; calyx 2-3 cleft or parted; staminate flowers, several together in the axils of the bractlets, stamens 2 or 3 pistillate flowers solitary in the axils of the lower bractlets; capsule 3-celled and 3-seeded. About 15 species of tropical America and the Pacific Islands.

Stillingia sylvatica L. Queen's Delight

A bright green herb 1-3 feet high; leaves nearly sessile lanceolate or elliptical, 2 glandular base; flowers lemon-colored subtended by small bracts with saucer-shaped glands; calyx cup-shaped; capsule depressed; seeds ovoid, light gray, minutely pitted and a flat base.

Distribution. From Virginia to Florida, Texas and Kansas in light sandy soil.

Poisonous properties. This plant is commonly used in medicine. It is said to be an efficient alterative. It contains an acrid resin *sylvacal* and an acrid fixed oil.

SAPINDALES

Trees, shrubs or herbs; petals usually present and separate; sepals usually distinct; stamens rarely more than twice as many as the sepals or fewer; opposite or alternate; ovary superior, compound; ovule pendulous. Contains many tropical plants, some with milky juice. In the family *Buxaceae* is the common box (*Buxus sempervirens*) which is used as a hedge plant and furnishes the best wood for wood engraving. The plant is an acrid poison. It is sometimes substituted for hops in the manufacture of beer and thus becomes the occasion of serious accident. The edible crowberry (*Empetrum nigrum*) belongs to the family *Empetraceae* and occurs far northward in America and Europe. The bladdernut (*Staphylea trifolia*) of Atlantic North America belongs to the family *Staphyleaceae*. The family *Sapindaceae* contains the balloon vine (*Cardio-*

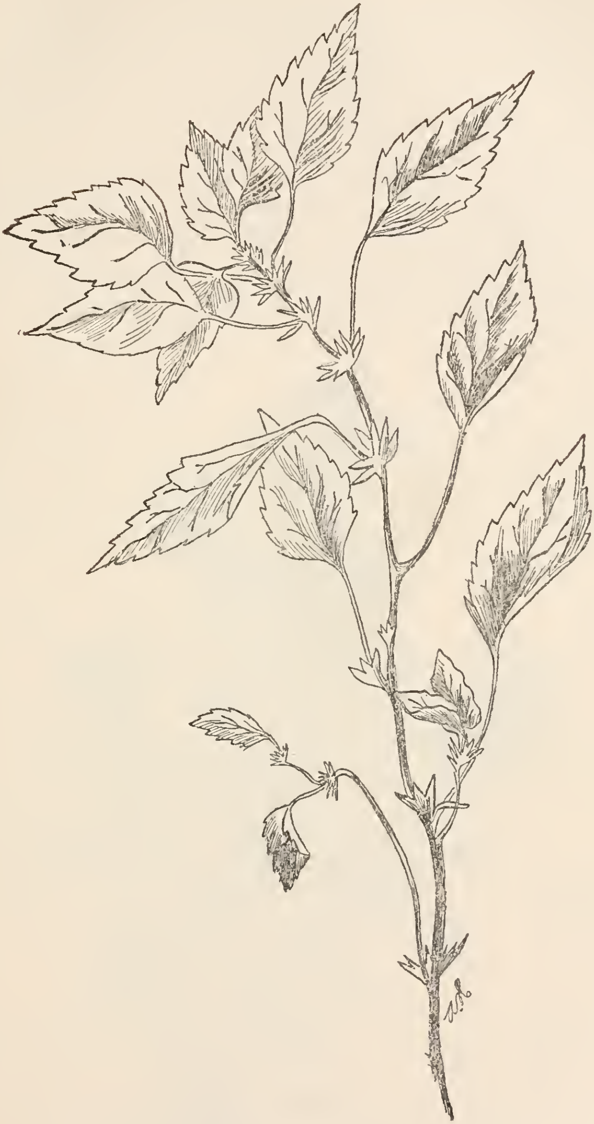

Fig. 340. Three-seeded Mercury (*Acalypha virginica*). Supposed to be poisonous to cattle. (Ada Hayden.)

spermum Halicacabum), a well known ornamental climber, but a weed in the South. A refreshing drink is made fom the seed of guarana (*Paullinia Cupana*) of South America; it contains *caffein, saponin* and an acrid green fixed oil. The fruit of *Sapindus Saponaria* contains a great deal of *saponin* and is used as a substitute for soap. The soapberry tree (*Sapindus marginatus*) is used as a shade tree in the South where it is a native. A shellac is derived from the Indian *Schleichera trijuga* and marcassa oil is obtained from the seeds of the same plant. The Indians of Brazil use the honey collected by wasps fròm the flowers of *Serjania lethalis* to poison their arrows. It is also used as a fish poison and contains a narcotic principle which causes death. Another fish poison is furnished by the black seeds of *S. curassavica* of Brazil. The natives use the same substance for criminal purposes on man. The nectar obtained from the flowers is also poisonous. Lehmann lists as poisonous *S. nodosa,* which is used by the natives of Brazil as an arrow poison. The fruit of *S. trifoliatus* of India contains *saponin.* The same substance occurs in other

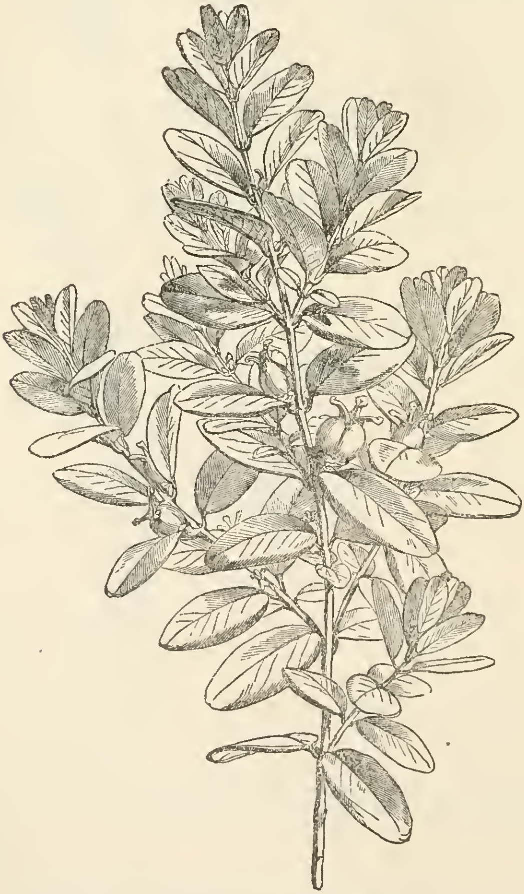

Fig. 341. Common Box (*Buxus sempervirens*). The plant is acridly poisonous. (After Faguet.)

species, notably in the seeds of the Brazilian *Magonia*. Narcotic principles occur in the following genera: *Serjania, Nephelium, Magonia* and *Harpullia.* The fruit of the litchi (*Nephelium Lit-chi*), a native of China and the Philippines and cultivated in the tropics, is something like a plum and is eaten fresh or dried. The *Blighia sapida* of West Africa is cultivated for its edible arillus; the *Koelreuteria paniculata* of China is cultivated as an ornamental plant.

The family *Coriaceae* contains the genus *Coriaria.* The leaves and bark of the *C. myrtifolia* of southern Europe contain much tannin which is used in dyeing. The *C. ruscifolia* of New Zealand contains a black dye. The fresh leaves are used in making an intoxicating drink. *C. myrtifolia* and *C. thymifolia* of Mexico contain a toxic principle known as *coriamyrtin* which resembles *picrotoxin.* Many species of the genus are poisonous. *Coriaria sarmentosa, C. arborea,* and the tree-toot (*C. Tutu*) of New Zealand are poisonous. Easterfield & Ashton * have isolated a crystallin glucoside called *tutin* $C_{17}H_{20}O_7$ which appears to be closely allied to *coriamyrtin* $C_{15}H_{18}O_5$. Tutu plants are highly toxic to animals that have not become immune by first becoming accustomed to small quantities. Blyth says:

> For the native cattle in the Tutu districts apparently consume moderate amounts of the shrubs with impunity, whereas other cattle become seriously ill. Both *coriamyrtin* and *tutin* belong pharmacologically to the *picrotoxin* group of substances. *Tutin* is somewhat less toxic that *coriamyrtin.* There is first depression, followed by salivation; the pulse is slowed, the respirations increased in frequency, and finally, clonic convulsions occur: 129 mgrms. killed a kitten weighing 1 kilogramme in 40 minutes; 1 mgrm. induced in a cat, 2 kilogrms. in weight, a convulsive seizure, and the animal did not recover for 24 hours.

Other important families of this order will be described farther on.

Families of Sapindales

- Flowers regular.
  - Ovary 1-celled; fruit a drupe.............................Anacardiaceae.
  - Ovary 2 or more celled.
    - Leaves simple.
      - Seed with an aril ....Celastraceae.
      - Seed without an aril ....Aquifoliaceae.
    - Leaves simple, palmately veined or compound.
      - Leaves opposite .... Aceraceae.
- Flowers irregular.
  - Leaves palmately compound; fruit a leathery capsule.
    - Trees or shrubs ....Hippocastanaceae.
    - Succulent herbs; capsule elastically dehiscent..........Balsaminaceae.

ANACARDIACEAE. Cashew Family

Trees or shrubs with acrid properties, milky or resinous juice; alternate or opposite leaves; flowers small, frequently polygamous, regular; calyx 3-7-cleft; petals of the same number; stamens as many or twice as many as the petals, inserted at the base of the disk; ovary 1 or sometimes 4 or 5-celled, and 1 ovule in each cavity; styles 1-3; fruit generally a small drupe; endosperm scanty; cotyledons large.

There are about 500 species in temperate and tropical regions. The cashew (*Anacardium occidentale*) is much cultivated in the tropics. According to Dr. Cook, the fleshy receptacles of the fruit are used in the West Indies in preparing conserves and have an acid flavor which is very palatable; the pericarp, however, contains an irritant substance *cardol* $C_{21}H_{30}O_2$, which is black, acrid and vesicating, and is used to protect books and furniture from insects; cashew oil, equal to the finest almond oil and superior to olive oil, is also a product of the plant. The juice of the shell of the nut produces poisoning similar to that of poison ivy. The kernels of the cashew may be eaten raw or roasted like chestnuts, but the fumes coming from the roasting nuts are very caustic. The pistachia nut (*Pistacia vera*) produces a fruit about the size of a plum, which contains a seed much prized for eating. The mango (*Mangifera indica*) a native of India, is now cultivated in most warm countries for its fine edible fruit. The bark of many species, like the smooth sumac (*Rhus glabra*) of the North, and the European *R. Coriaria,* contains a valuable tanning material. The smoke tree (*Rhus Cotinus*) and the stag horn sumach (*Rhus typhina*) are frequently cultivated for ornamental purposes. The fruits of *Spondias dulcis, S. purpurea* and *S. lutea* are edible, the last of these is called the hog plum, being so named because the hogs are fond of it. The juice of another member of the family (*Comocladia*) causes an eruption similar to that from poison ivy.

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* Jour. Chem. Soc. Trans. 1901.

Tannic and pyrogallic acids are derived from the Chinese Indian *Rhus semialata.* Chios turpentine (*Pistacia Terebinthus*) well known to the ancients, produces red galls that are used for tanning morocco leather. The mastic (*Pistacia Lentiscus*) native to the Mediterranean region, was formerly used for making varnishes.

The *Querbrachia Lorentzii* and *Q. Balansae* of Argentine and Paraguay produce a very hard red wood which contains a great deal of *tannin* and *gallic acid.* The fruit of *Dracontomelon mangiferum* of the Sunda islands is used much like lemons. The ink tree of India (*Semecarpus Anacardium* and *Holigarna ferruginea*) contain *cardol.*

The pepper tree (*Schinus Molle*) cultivated in California, is a native of Peru. The saw-dust of sneezewood (*Ptaeroxylon utile*) produces sneezing.

Rhus L. Sumach

Trees or shrubs with alternate, simple trifoliolate or odd-pinnate leaves; small polygamous flowers in panicles; calyx deeply 5-parted; petals 5, spreading; stamens 5, inserted below the flattened disk, fruit small, 1-seeded. About 120 species in the temperate regions common in southern Africa. Some species are poisonous. The Japanese *Rhus vernicifera* and *R. succedanea* are cultivated in Japan for the lacquer which is taken from incisions made in the trees. Dr. White states that some of the embossed Japanese papers which are used in houses have caused severe inflammation, and according to Dr. H. N. Allen, natives as well as Europeans in the East are often affected with "varnish poisoning"

Rhus Toxicodendron L. Poison Ivy. Three Leaved Ivy

A climbing or trailing shrub, sometimes erect, with 3 leaflets; plant erect or climbing by means of its aerial rootlets; flowers inconspicuous, polygamous in loose and slender axillary panicles; fruit globular, glabrous, whitish and waxy, frequently remaining on the plant until late spring.

Distribution. This plant is distributed from Nova Scotia to Wisconsin, Utah, Arkansas and Florida.

Rhus Vernix L. Poisonous Sumac or Dogwood

A shrub or small tree with pinnately compound leaves; leaflets 7-13, obovate-oblong entire, smooth, or somewhat pubescent; flowers polygamous in loose slender axillary panicles; drupe white, globose, oblong.

Distribution. Found in the swamps from New England to Ontario to Minnesota, Missouri, to Louisiana and Florida.

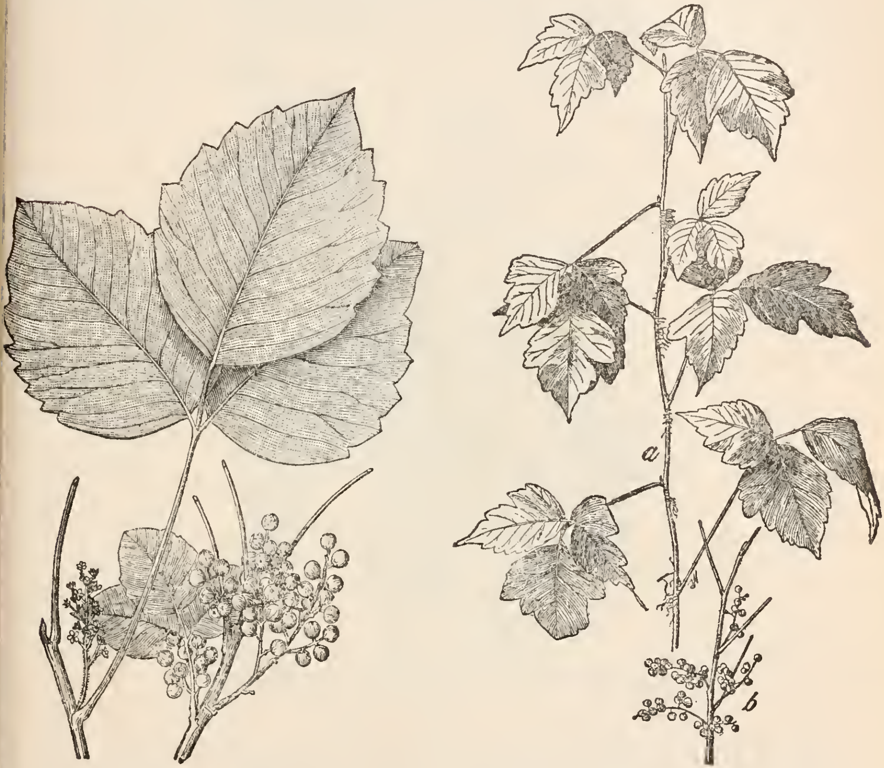


Fig. 342. Poison ivy (*Rhus Toxicodendron*). a, spray showing aerial rootlets and leaves; b, fruit—both one-fourth natural size. (Chesnut, U. S. Dept. Agr.)

Rhus diversiloba Torrey and Gray. California Poison Ivy

Nearly glabrous, erect or climbing shrub; leaflets 3 or rarely 5, obtuse or deeply pinnately lobed; flowers in loose axillary panicles; drupes subglobose.

Distribution. Common on the Pacific Coast from California to Washington.

Poisonous properties. All three species are poisonous to many persons, some persons being much more sensitive to irritation from the plants than others Dr. J. C. White describes the effect of poison oak and poison ivy. He had collected freely of the plant for many years without any disturbance. Specimens were picked on September 28th, Oct. 6th, and Oct. 10th. He felt

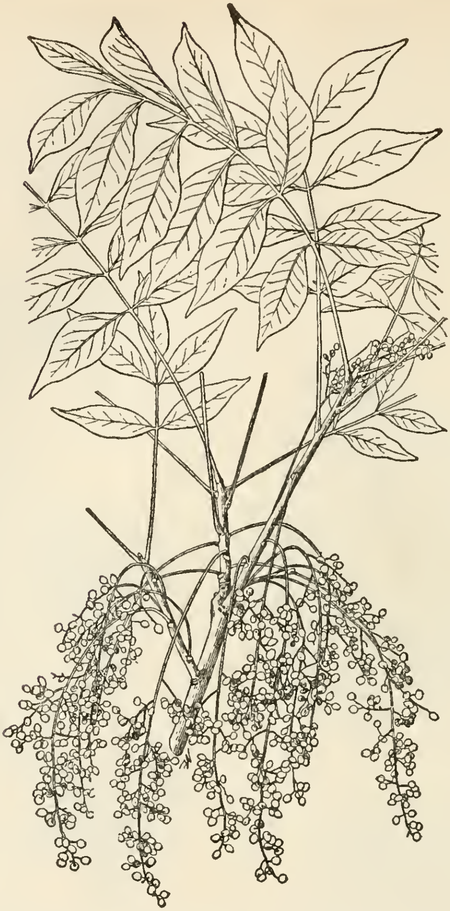


Fig. 343. Poison Sumac (*Rhus Vernix*), showing leaves, fruit and leaf-scars, one-fourth natural size. (Chesnut, U. S. Dept. Agr.)

a sensation of irritation about the eyes and throat from the specimens of poison oak collected on the first named date, while working with the plants under an Argand gas burner, but nothing further was noticed. No unpleasant symptoms were observed from the poison oak (*R. venenata*=*R. Vernix*) collected Oct. 6th. From that collected Oct. 10, he experienced symptoms similar to those observed Sept. 28th. On Oct. 12th a single vesicle with a peculiar thick cover appeared; the next day another and larger appeared on the wrist; two others came on the fourth day; others continued to appear up to Nov. 3rd, after which data the effervescences gradually subsided and were no longer perceptible. In another case described by Dr. White, the head was greatly swollen and features greatly disturbed. The skin of the face and neck was deeply oedematous and largely covered with vesicles of all sizes "many of which were seated on an erythematous base, others being still in their papular stage of development." There were also large excoriations from which fluid was exuding freely, which on drying formed small crusts. The hands were also covered. "The subjective symptoms were great retching and burning of the parts affected, with the feeling of local discomfort, consequent upon so great swelling of the features. The eyes were nearly closed. There was a slight general febrile action." Dr. White also reports the death of a child from a severe case of poisoning from poison ivy. The child though healthy was not robust. A recent case was reported from Packwood, Iowa, where a fourteen-year-old girl died after terrible suffering from the effects of coming in contact with the ivy; her face alone showing the eruption from the poison.

Hundreds of persons are poisoned every year from the three species. Dr. White says:

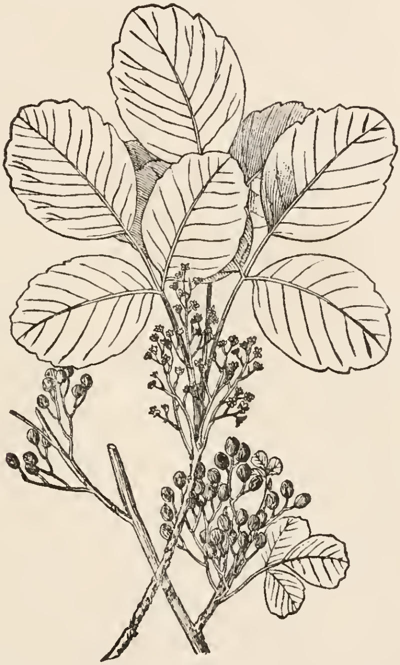


Fig. 344. Poison oak (*Rhus diversiloba*), showing leaves, flowers, and fruit, one-third natural size. (Chesnut, U. S. Dept. Agr.)

> Taking the simple vesicle, with scarcely any erythema surrounding it or any very perceptible infiltration of the underlying tissues, as the type of the eruption, whether occurring singly or in groups, we may have in a small percentage an abortive attempt at vesiculation, and an arrest of the development at the papular stage—a failure, that is, of the free exudation to force apart the layers of epithelial cells; or a considerable infiltration into the papillary layer may elevate a cluster of the vesicles noticeably above the general surface. or they may be surrounded by a well-defined erythema or congestion of the tissue immediately surrounding them, in consequence mainly of the scratching and itching, which are the only subjective symptoms present.
>
> In the severe cases, we have greater areas of simple erythema, a multiplication of the number of vesicles—either single or massed in close contiguity, and covering large surfaces, or by fusion forming blebs—a greater infiltration into the underlying corium, with proportionate distension of the capillaries and external redness, and a free exudation of serum into

the cutis. The overfilling of the vesicles causes a rupture of some of their epidermal coverings, and the discharge of their fluid contents upon the surface, forming moist, excoriated surfaces, covered in part with crusts.

With reference to a sequelae question of duration, there is a diversity of opinion. There is a popular belief that within a year after the first attack there will be a repetition of the original manifestations upon the skin which may be repeated for several seasons. Dermatologists think that a variety of cutaneous affectations are developed in consequence of the action of the Poison Ivy. Dr. White considers that there are good grounds for this belief and in referring to his exhaustive researches on the subject, states that he was unable to find a single instance on record of the poisonous Rhus on the lower animals. After placing a notice in the "Spirit of the Times," a physician wrote him that once or twice while hunting where ivy abounded, his dog's eyes had been closed by swelling which he attributed to the action, but he had never observed any eruptions. The poisoning has been attributed to *toxicodendrol* $C_{27}H_{42}O_{10} + 4H_2O$.

Remedies. The most popular remedy is to wash with sugar of lead (acetate of lead). Prof. Chesnut says:

> In practise it is not desirable to use strong alcohol, which is apt to be too irritating to a sensitive surface, but a weaker grade of from 50 to 75 per cent should be preferred. To this the powdered sugar of lead is to be added until no more will easily dissolve. The milky fluid should then be well rubbed into the affected skin, and the operation repeated several times during the course of a few days. The itching is at once relieved and the further spread of the eruption is checked. The remedy has been tried in a large number of cases and has always proved successful. It must be remembered, however, that the lead solution is itself very poisonous if taken internally.
>
> Much has been said in regard to the relative poisonous character of these three plants. It has been generally claimed that the poison sumac is the most poisonous, and after it comes, first, the poison ivy and then the poison oak. These conclusions were arrived at from the occasional experience of individuals who were poisoned by handling one species when supposedly immune to others. Experience teaches, however, that immunity is somewhat variable in the same individual, and therefore these general statements can not be accepted without more careful experimental evidence.

Annie Oakes Huntington in her recent book on Poison Ivy and Swamp Sumach says regarding the treatment:

> Soap, water, and a scrubbing-brush seem altogether too simple a method of treatment to advise for the painful eruption brought on by handling these two poisonous plants. Yet, if we begin with this old-fashioned country remedy and study the various methods of treatment from one generation to another, we return at last, through the most recent scientific investigations, to our original starting-point. The only effective measures are preventive ones; the only remedy is a wash which mechanically removes the poisonous oil from the skin. In this lies the sum and substance of the entire method of treatment.

She made an experiment in which it was shown that oily preparations spread the poison and that constant washing with soap and water removes the poisonous oil which causes the trouble. The toxic principle is soluble in alcohol and this may consequently be used. A weak solution, 50 or 75% is advisable, but the treatment must be renewed. One part of hyposulphite of soda to 3 parts of water is another good solution recommended by her.

Syme in Dr. Remsen's laboratory, has come to the conclusion that the active principle of Poison Ivy is a glucoside and not an unknown volatile oil, as stated by Pfaff. The glucoside as determined by Syme, is a compound of *rhamnose, gallic acid,* and *fisetin.* It can be precipitated by a lead acetate. Syme tested the toxic action of the various fractions upon himself and was able to determine the chemical nature.

In a recent paper by Dr. Ford there seem to be some evidences for concluding that immunity may be obtained. That such immunity exists may be taken from the clinical symptoms that different persons are sensitive to even small amounts of the poison and in other cases persons who have been poisoned become accustomed to it. Syme in his experiments upon himself found that after four or five months he was no longer susceptible to the poison.

The experiments performed by Dr. Ford are of interest. The experimental material was obtained in the alcoholic fluid extract of the native plant prepared by Parke, Davis & Co.

> It had already been shown by Pfaff that the internal administration of his non-volatile oil produced definite lesions in rabbits, the animals dying of an acute nephritis at the end of 14 to 15 days. Occasionally the rabbits died in acute convulsions without any microscopic brain lesions. The subcutaneous administration of the fluid extract of *Rhus Toxicodendron* produces the same effect upon rabbits as those described by Pfaff. Rarely, the rabbits die in convulsions within 24 to 48 hours, but the majority of inoculated animals succumb in from 8 to 15 days. In addition to the nephritis an extensive necrosis and slough is found at the point where the poison is introduced beneath the skin. Following the inoculation we have a fairly long latent period during which the weight of the animals remains stationary. After seven or eight days in a typical case, the animal loses weight rapidly, the necrosis and slough develop, and the animal dies of the nephritis after the lapse of about two weeks. At times the skin lesions are less marked, the damage to the kidney being the important change; an intraperitoneal inoculation seems able to produce these kidney changes more rapidly than does the subcutaneous method. In addition to rabbits we have found that guinea-pigs are susceptible to the drug, the lesions being produced with greater certainty and regularity. With these animals the necrosis and slough at the point of inoculation are more extensive, while the animals die of the kidney changes in about the same time. The fatal dose of the poison can be estimated for both animals with tolerable accuracy. For guinea-pigs of 250 gram weight, 0.25 c.c. of the alcoholic extract always represents a fatal dose; and a guinea-pig of 350 gram weight practically never survives a dosage of 0.5 c.c.
>
> The fatal dose for rabbits of 800 grams is 1 c.c. Certain rabbits of this weight die from smaller doses, but not regularly and larger animals show greater resistance. Animals of 1,800 to 2,000 gram weight occasionally survive 2 to 3 c.c. doses, but not more than this amount.

Experiments were made to determine whether animals which had withstood some doses of the poison were susceptible to the amounts of poison capable of killing untreated animals. The experiments were made with four guinea pigs, varying in weight from 450 to 900 grams and on rabbits varying in weight from 800 to 2800 grams. The initial doses were small; when the animals regained weight larger doses were given. It was found that the serum of immunized animals contained substances neutralizing the poisonous glucoside when both were injected into susceptible animals. Goats have been immunized and it is probable that immunity may be obtained in other animals.

How to Treat the Poison Ivy Patch. Various methods of treating the poison ivy have been tried. The iron sulphate, 100 pounds to a barrel of water, is only partially successful. Covering with tarred paper creosoted below is effective according to Dr. G. E. Stone. This writer has also shown that sodium arsenate (commercial) at the rate of 2 pounds to 10 gallons of water poured around the roots is effective.

Rhus glabra L. Smooth Sumach

A low shrub from 2-12 feet high, stems with large pith, brownish bark; compound leaves 11-31; leaflets pointed serrate, whitish beneath green above; flowers borne in a large panicle, greenish, polygamous; calyx small 5-parted: petals 5; stamens 5, inserted under the edge of a flattened disk; pistil with a 1-celled and 1-ovuled ovary; styles 3, terminal; fruit red, small 1-seeded.

Distribution. Common in Northern United States to Florida, Mississippi, Arizona, Utah, British Columbia to Nova Scotia. A troublesome weed at times in rocky soils.

Poisonous properties. There is a popular impression that the red drupes of this species are poisonous, but I know of no record where the eating of this fruit has produced poisoning. The fruit is decidedly acid.

AQUIFOLIACEAE. Holly Family.

Trees or shrubs with small, simple, mostly petioled, alternate leaves; flowers in axillary clusters, chiefly polygamo-dioecious; calyx minute, free; petals 4-8 or more; stamens free, as many as the petals; pistil 1, ovary superior, 4-8 celled; ovules 1-2 in each cavity; fruit a small berry-like drupe; seeds with small embryo; endosperm present.

A small order of 160 species. The American holly (*Ilex opaca*) from Maine to Florida, Missouri and Texas, is much used for Christmas decoration. The European holly (*IlexAquifolium*) is used for a similar purpose. The berries of this species, though eaten by birds, are said to be poisonous. Whether the seeds of the American species are poisonous is not known although it contains the principle *ilicin.* The *Ilex Cassine,* which ocurs from southern Virginia to Florida and Louisiana along the coast, was used by the Indians during their religious ceremonies to make what they called their "black drink," an emetic intended to clear the head and stomach. It contanis *caffein.* The yerba or maté (*Ilex paraguensis*), native to southern Brazil and Argentine Republic is used like the Chinese tea and is stimulating. Properly the term "maté" is applied to the drinking cup made from a small gourd. Yerba is an important article of commerce in South American countries. The leaves contain the same active principle, *caffein,* that is found in the tea. Two other species *I. theezans* and *Symplocos lanceolata* also furnish the maté. The wood of the larger trees of the genus, like *Ilex opaca* and *Ilex Aquifolium* is white and is used by cabinet makers.

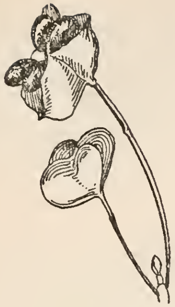
CELASTRACEAE. Staff-tree Family

Shrubs, or trees, with simple leaves; stipules small or absent; flowers regular, usually perfect; calyx 4-5-lobed; petals 4-5; stamens inserted on a flat or lobed disk; pistils with 3 or 5-celled ovary; ovules 2 in each cavity; fruit 2 to 5-celled, fleshy; seeds with an aril, embryo large, and fleshy endosperm. About 350 species of wide distribution.

The burning bush or waahoo (*Euonymus atropurpurens*) is a well known native, frequently cultivated and is a most desirable shrub. The *Catha edulis* of Arabia is extensively cultivated and is used as coffee by the Arabs. The leaves are also chewed by the natives, having a stimulating effect similar to that of cocain. It contains the alkaloids *cathin and celastrin.* The *Elaeodendron australe* of New South Wales is used for cabinet work. The genus *Pachistima* is represented in the Rocky Mountains by *Pachistima Myrsinites,* and in the Alleghany Mountains by *Pachistima Cambyi* both of which are pretty shrubs.

Celastrus L. Staff-tree. Bitter-sweet

Mostly climbing shrubs; leaves thin; flowers racemose or paniculate; polygamo-dioecious; calyx 5-lobed; petals 5, crenulate, inserted under the disk;



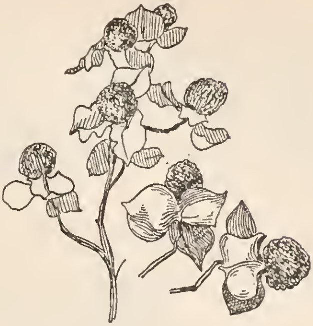


Fig. 345. **Waahoo** (*Enonymus atropurpureus*). 345a. Bitter sweet (*Celastrus scandens*).

pod globose, orange color, 2-4-celled dehiscent into as many valves; seeds enclosed in a scarlet aril; endosperm fleshy. About 30 species.

Celastrus scandens L. Shrubby or Climbing Bittersweet

Chiefly climbing shrubs with alternate leaves; flowers small, polygamo-dioecious; calyx 5-lobed; petals 5; stamens 5, inserted under the 5-lobed disk; capsule globose, orange-colored, 3-celled and 3-valved; seeds 1-2 in each cell, enclosed in a pulpy aril. About 30 species. The *C. articulatus* and several other species are commonly cultivated and are hardy. Several species are natives of the Cape of Good Hope.

Distribution. From Quebec to Manitoba in Canada, and from Kansas to Indian Territory, New Mexico and the Carolinas.

Poisonous properties. The aril of "Bitter-sweet" has a sweetish, somewhat disagreeable taste. The leaves of the plant are said to be poisonous to horses. The plant *Euonymous* contains the amorphous bitter, odorless substance, *euonymin*, which acts as a powerful heart poison. The waahoo acts as a drastic purgative. The symptoms are those of deathly nausea, vertigo, prostration and cold sweat.

ACERACEAE. Maple Family

Trees or shrubs with opposite, simple or compound leaves; flowers polygamous or dioecious in cymose or racemose clusters; calyx 5-parted; petals of the same number or none; stamens 4-12, inserted on a fleshy disk; ovary 2-lobed and 2-celled; styles 2, fruit a samara, exalbuminous; cotyledons thin, folded. There are 3 genera and about 100 species most of them in the genus *Acer,* the maples being widely distributed in temperate regions. The maple, (*Acer*) is commonly used for the manufacture of furniture and for inferior finishings, floorings, etc. The most highly prized are the hard maples (*Acer nigrum* and *A. saccharum*). Sugar maple is also derived from these species. Curly maple is only a form of wood of these and of the *A. macrophyllum* of the Pacific Coast, which is also much prized for cabinet work. The maples, including the box elder (*Negundo aceroides* or *A. Negundo*), are also used for shade trees. The silver maple (*A. saccharinum*) is widely distributed in the United States. The red maple (*A. rubrum*) is less commonly used. The bark of *A. rubrum* was used by the Indians as a remedy for sore eyes.

HIPPOCASTANACEAE. Buckeye Family

Trees or shrubs; leaves opposite, petioled, digitately 3-9-foliolate; flowers in terminal panicles, irregular and polygamous; calyx 5-lobed or 5-cleft; petals 4-5, unequal, clawed; disk entire; stamens 5-8; ovary sessile, 3-celled; ovules 2 in each cavity; style slender; capsule leathery, smooth or spiny, 1-3-celled; seeds large shining; cotyledons very thick. Only 2 genera and 15 species in America and Asia.

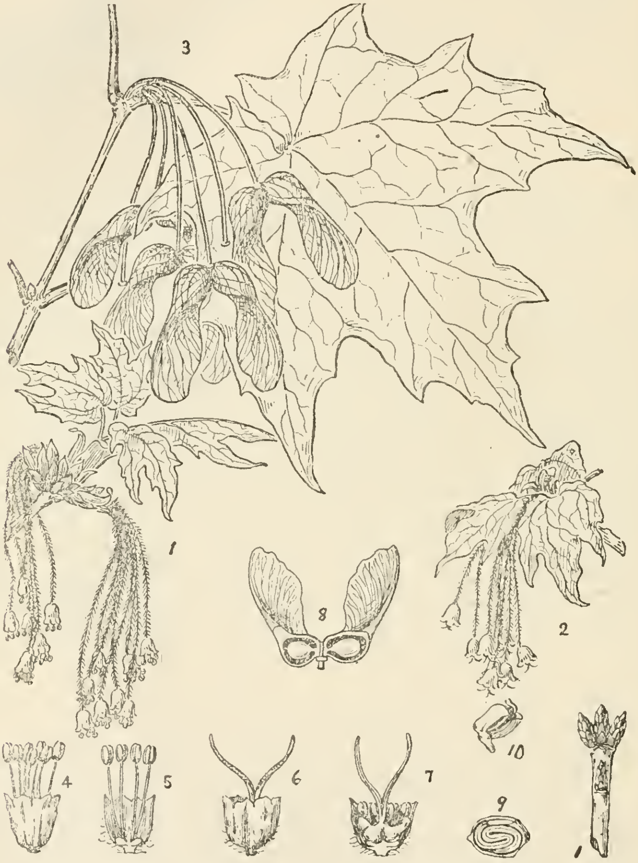


Fig. 346. Sugar maple (*Acer saccharum*). 1. Branch bearing staminate flowers. 2. Branch bearing pistillate flowers. 3. Fruiting branch. 4. Staminate flower, enlarged. 5. Longitudinal section of staminate flower, enlarged. 6. Pistillate flower, enlarged. 7. Longitudinal section of pistillate flower, enlarged. 8. Longitudinal section of fruit. 9. Longitudinal section of seed, enlarged. 10. Embryo, enlarged. 11. Winter branchlet. 1, 2, 3, 8, 11, one-half natural size. (M. M. Cheney in Green's Forestry of Minn.)

Aesculus L. Buckeye

Trees or shrubs with opposite petioled digitately 3-9-foliolate leaves; flowers in panicles, irregular, polygamous; calyx 5-lobed, lobes unequal; petals 4-5, unequal, clawed, stamens 5-8; filaments long, often unequal; pistil with 3-celled ovary and two ovules in each cell; capsule leathery; seeds large with shining coat; cotyledons thick and fleshy. A small genus of 15 species native of America and Asia. The horse chesnut (*Aesculus Hippocastanum*), escaped from cultivation is planted for ornamental purposes, as are others of the genus, like the species described below and *A. parviflora,* a small shrub. By washing and boiling, the starch in the seed may be utilized, and this is done in France with the horse chesnut. The wood is light and brittle. The wood of the Ohio buckeye is used for making violins.

Aesculus glabra Willd. Ohio Buckeye

Trees with long-petioled leaves; rough and fetid bark; flowers pale yellow, in large panicles, polygamo-monoecious; calyx bell-shaped; stamens exserted, curved; petals unequal; fruit slightly prickly when young, smooth when old.

Distribution. Western Pennsylvania to Central Iowa, Kansas and Indian Territory.

Aesculus Pavia L. Red Buckeye

Shrubs with 5-7 digitate, nearly smooth, leaflets, acute or short acuminate, pubescent when young, becoming smooth; flowers in loose peduncles; calyx tubular, bright red; petals bright red.

Distribution. In fertile valleys from Virginia to Florida, Arkansas and southern Missouri.

Aesculus Californica Nutt. California Buckeye

Usually a shrub from 10-15 feet high, or occasionally a tree from 25-40 feet high, 3 feet in diameter; leaflets 4-7, usually 5, smooth, oblong-lanceolate, acute, petiolate; flowers in a close panicle; calyx 2-lobed; petals somewhat unequal, white or pale rose, ½ inch long; stamens 5-7; ovary densely pubescent; fruit usually 1-seeded.

Distribution. In California.

Poisonous properties. The leaves and fruit of the above species are regarded as poisonous. Many farmers claim that this is true only at certain seasons of the year. The seed produces sneezing and enters into the manufacture of snuff. The California species, according to Chesnut, causes abortion in cows. Dr. Rusby states that in southern states the seeds are crushed and thrown into water to stupefy fish just as the bark and roots of the relatives are in the tropics. Fatal cases of poisoning of children are reported from Texas. Suspicion has been attached to the common horse chestnut. The European chestnut is said to be useful in affording food for live stock, especially sheep and goats. This species contains aesculin $C_{15}H_{16}O_9+H_2O$, a glucoside found in the bark of many trees of the order *Sapindacae;* also the glucoside *aesculetin* $C_9H_6O_4$; and *paviin* $C_{32}H_{36}O_{20}$; the testa of the seed contains *quercetrin* $C_{27}H_{30}O_{17}$; *argyraescin,* an acrid, amorphous glucoside; *aphrodaescin,* also an acrid, amorphous principle; and *saponin* $C_{32}H_{54}O_{18}$, a glucoside which is also found in the roots of *Polygala Senega,* and other plants. Dr. Millspaugh states that the horse chestnut causes inflammation of the mucous membranes of the respiratory and digestive tracts, and especially of the rectum; constant burning in the stomach and epigastrium, followed by nausea, retching, and violent vomiting with great tenderness and colic throughout the ab-

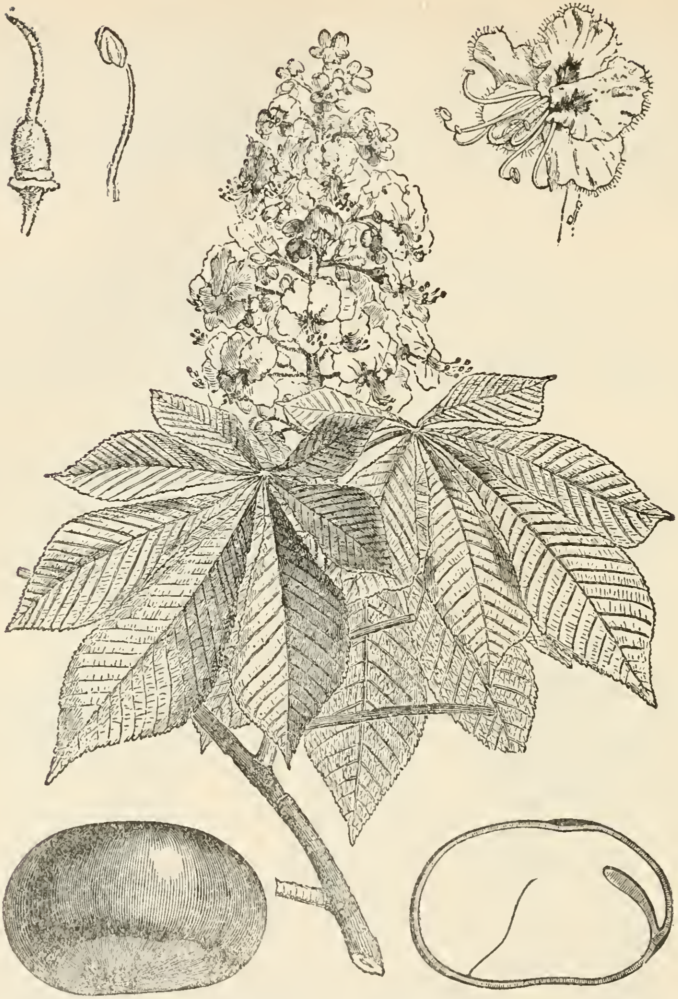


Fig. 347. Horse Chestnut (*Aesculus Hippocastanum*). Flowering branch. Entire flower. Stamen. Pistil. Entire seed and longitudinal section. Wood used in making violins. (After Faguet.)

domen, are markedly present. The buckeye is an irritant of the cerebro-spinal system, the more prominent symptoms being confusion of mind, vertigo, stupefaction and coma.

BALSAMINACEAE. Balsam Family

Succulent herbs; leaves alternate; thin, petioled; flowers axillary showy, irregular; sepals 3, the two lateral small, green; the posterior large and petal-like, spurred; petals 3 or 5, some 2-cleft; stamens 5; ovary oblong 5-celled; style short or none; stigma 5-toothed or 5-lobed; ovules several in each cell; fruit a capsule in *Impatiens,* coiled elastically, expelling the seeds; seeds

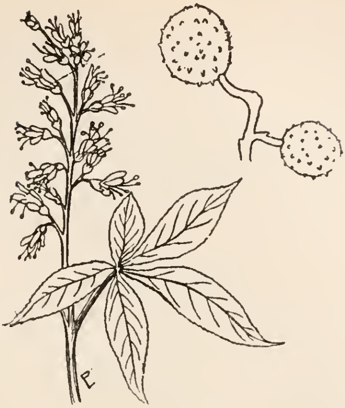


Fig. 348. Ohio Buckeye (*Aesculus glabra*). Causes irritation of the cerebrospinal system. (Lois Pammel.)

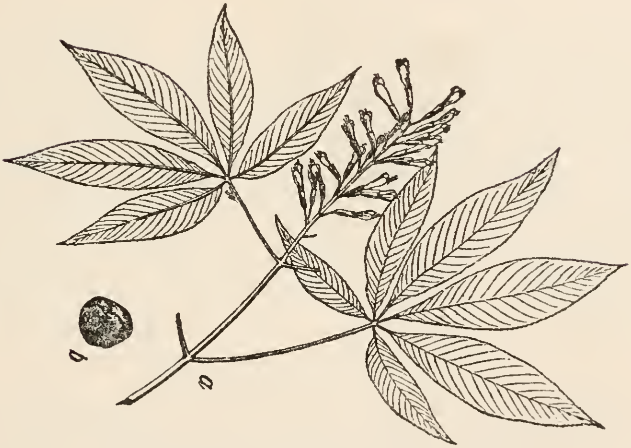


Fig. 349. Red Buckeye (*Aesculus Pavia*): a, flowering branch; b, seed; both two-ninths natural size. (Chesnut, U. S. Dept. Agr.)

ridged; embryo straight. About 200 species mostly of tropical Asia. One genus with 2 species is native to eastern North America. The Balsam (*Impatiens Balsamina*) is frequently cultivated. The sap of some species contains a dye.

Impatiens L. Jewel Weed

Succulent herbs with simple, thin, petioled leaves; sepals 3, the 2 alternate small, green, the posterior one largest, and forming a spurred sac; petals 5, or 3, with 2 of them 2-cleft into dissimilar lobes; stamens 5, short; ovary oblong, 5-celled; fruit an oblong or linear capsule, dehiscent elastically into a coiled valve, scattering the seeds; endosperm none; embryo nearly straight; cotyledons flat.

Impatiens biflora Walt. Spotted Touch-me-not

A glabrous annual from 2-4 feet high; leaves ovate or elliptical, pale and glaucous beneath; flowers orange-color, thickly spotted with brown; peduncles 2-4 flowered.

Distribution. In moist grounds from Eastern Canada to Florida, to Kansas and northward to Oregon and Alaska.

Poisonous properties. Dr. Schaffner states that the plant is emetic and suspected of being poisonous to stock.

RHAMNALES

Shrubs, vines or small trees; leaves generally alternate; flowers small regular; sepals generally more or less united; petals distinct or wanting; stamens as many as the calyx lobes and alternate with them, opposite the petals when present; ovary superior, compound; ovules erect. They contain two families, the *Rhamnaceae* and *Vitaceae.* The genus *Vitis* embraces 40 species found in warm and temperate regions. The European grape (*Vitis vinifera*) native from Eastern Europe to Central Asia is now widely cultivated in California, Spain, Germany, the Cape region and elsewhere. The Worden and Concord grape (*V. Labrusca*) of eastern North America are also widely cultivated. Other species are, the small grape (*V. aestivalis*), the wild blue grape (*V. bicolor*) native from New York to Wisconsin, the southern fox grape (*V. rotundifolia*) with musky flavor, cultivated in the South, the cultivated northern fox grape (*V. riparia*) with very fragrant flowers. Improved forms are the Janesville and Clinton. The fruit of the mustang grape (*V. candicans*) of Texas is very acrid. The Virginia creeper (*Psedera quinquefolia*) is a well known ornamental climber. The Boston or Japan Ivy (*P. tricuspidata*) native of Japan, is a handsome climber scarcely hardy north. The *P. heterophylla,* another ornamental from China and Japan is a hardy plant with small blue berries. It does not cling. The *Vitis inconstans* of Japan contains *toxicodendrol* and is poisonous.

RHAMNACEAE. Buckthorn Family

Shrubs, often climbing; or trees, often thorny, with astringent or bitter qualities; leaves chiefly alternate; stipules small, deciduous; flowers in cymes or panicles, small, regular; calyx perfect or polygamous, 4-5-toothed; petals 4-5, inserted on the calyx, or none; stamens 4-5, inserted on a disk which lines the calyx tube, which is often united with the single 2-5-celled ovary; ovules 1 in each cell; fruit often mucilaginous and drupaceous. A small family of 550 species, of temperate and warm regions.

The supple-jack (*Berchemia scandens*) is a pretty climber of southern woods. The buckthorn (*Rhamnus cathartica*) is frequently cultivated for hedges in the north. The juice of the unripe drupe was formerly used for staining maps and the ripe drupe is the sap green of painters. The sap has strong purgative properties. This and *R. Frangula* are local irritants. This plant contains *rhamnetin,* $C_{16}H_{12}O_7$, the *rhamnin* of earlier authors, a glucoside found in the berry. Dyes are obtained from *R. infectoria* and a dye for silks from *R. lahurica* and *R. tinctoria.* The *R. Frangula* contains *frangulin* and is an ornamental shrub, the charcoal from which is used for making gun powder. Probably all are more or less injurious. Cascara sagrada is obtained from *R.*

Purshiana, a shrub or small tree native to the Pacific coast which contains *purshianin* and is an excellent laxative. The *Paliurus australis* contains oil of wintergreen. The jujube (*Zizyphus sativa*) is used as food in South Europe and Western Asia. The Chinese *Z. Jujuba* is extensively cultivated in India and China. The fruit of *Z. Lotus* is made into a kind of bread, used by the natives of West Africa, but the ripe fruit is said to be injurious. The root of the New Jersey tea (*Ceanothus americanus*) is used as an astringent and expectorant and is also said to have been used in place of tea during the Revolutionary war. According to Greshoff the seeds of *Ceanothus americanus*, and *Ceanothus ovatus* contain a small amount of saponin. It is therefore not strange that some members of the family are poisonous. The genera *Zizyphus, Tapura* and *Gouania* furnish fish poisons. *Saponin* occurs in *Gouania tomentosa* of Mexico. *Colubrina fermenta* is used as a substitute for hops. The wood of *Colletia spinosa* of South America contains a bitter principle.

The brownish-black berries of coyotillo (*Karwinskia Humboldtiana*) of Texas are said to be very poisonous and Dr. A. Mitchell of San Antonio writes me that the plant is poisonous to goats.

MALVALES

Herbs, shrubs or trees; leaves simple, generally alternate; flowers regular, usually perfect; sepals separate or more or less united; corolla polypetalous or rarely wanting; stamens usually numerous; ovary superior compound; placenta axial. The more important families of this order are *Tiliaceae, Malvaceae, Bombaceae* and *Sterculiaceae*. The first family contains the basswood (*Tilia americana*), a well known timber and ornamental tree of North America, used for making boxes, lumber, excelsior, etc. *T. cordata* is also frequently cultivated under the name of Linn tree. The inner bark of this produces an elastic fiber. Several species of the genus *Grewia* are used as fish poisons. Jute is derived from *Corchorus capsularis* of the East Indies and is a valuable fiber. The broomweed (*C. siliquosus*) of the West Indies furnishes a substitute for tea. The fruit of *Apeiba* is edible. Corkwood (*Ochroma Lagopus*) of the family *Bombaceae* is used by the fishermen of Trinidad on their nets in place of cork and is one of the lightest of all woods. The monkey-bread tree (*Adansonia digitata*) produces valuable fiber in its bark. The silk cotton or kapok tree (*Eriodendron anfractuosum*) furnishes a soft fiber used in upholstery. The seed known as "kapok" seed is used in the Celebes as food and in making oil cake, and according to Reinders and Kobus, is an adulterant of linseed. The *Durio zibethinus* of the Malayan region produces a large edible fruit. The family *Sterculiaccae* of tropical countries includes the cacao (*Theobroma Cacao*) which produces the well known cacao beans. Cacao is a nutrient food and contains the alkaloid *theobromin*, $C_7H_8N_4O_2$, a caffein alkaloid. The cola nut (*Cola acuminata*) of West Africa is a stimulant. The negroes of Brazil used large quantitics because of its stimulating properties. It is also used for similar purposes by the negroes of the south ,and the "Cola habit" is increasing among the negroes of that region. It is probable that the cola is frequently adulterated with injurious ingredients. It is a muscle stimulant used by the Alpine climbers of Europe. Fresh cola nuts do not contain caffein, but a glucoside *kolanin* which is converted into *kolarea* $C_{14}H_{13}(OH)_5$. An

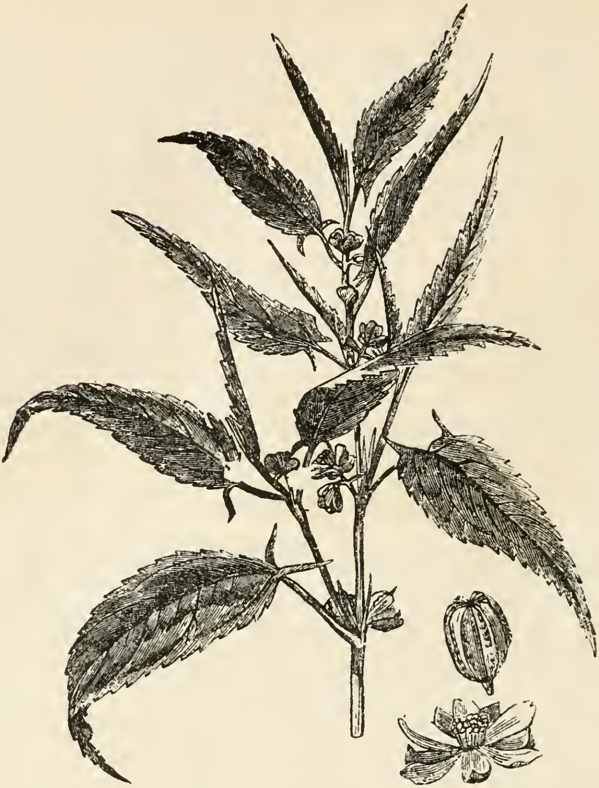


Fig. 350. Jute Plant (*Corchorus capsularis*). A valuable fiber plant from the East Indies. (From American Agriculturist.)

oil is manufactured from *Sterculia foetida.* The *Abroma augusta* yields a fine fiber.

To the family *Elaeocarpaceae* of the same order belongs the *Echinocarpus Sigun,* a poisonous plant which contains hydrocyanic acid. Several members of this family are economic plants. The maqui fruit is obtained from *Aristotelia Macqui,* native to Chili. The seeds of *Sloanea dentata* are eaten like chestnuts. The seeds of *Muntingia* are edible.

MALVACEAE. Mallow Family

Herbs, shrubs, or, in tropical countries, trees, with mucilaginous properties. tough fibrous bark and stems; leaves alternate and small; stipules small, deciduous; flowers regular and generally perfect; sepals 5, usually more or less united; petals 5, hypogynous; stamens numerous, monadelphous, several-celled; pistils several; styles united, projecting beyond the stamens above; ovary several celled; seeds nearly exalbuminous; embryo curved. A family of about 800 species of wide distribution and of great economic importance. The cotton plant is the most important member of the family and comprises several species, the most important in the United States being *Gossypium herbaceum,* which

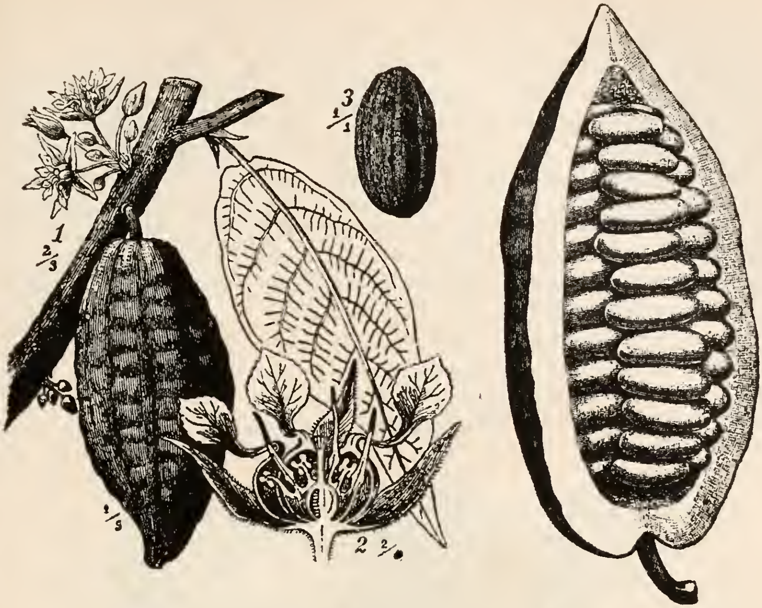


Fig. 351. Cacao Tree (*Theobroma Cacao*). 1. Branch with flowers and fruit. 2. Flower cut through longitudinally. 3. Seed. 4. Fruit with a portion of pericarp removed. The beans are well known articles of commerce. (After Wossidlo).

is cultivated for its fiber. The cotton fibers are plant hairs coming from the seed. Cotton seed is used to manufacture an oil serving in place of olive oil, and cotton seed meal, the latter a valuable stock food. The refuse material is used as a fertilizer. The highly explosive gun cotton is made by soaking cotton in sulphuric and nitric acids. Other cottons are Sea Island cotton (*G. barbadense*) and tree cotton (*G. arboreum*). The bark of cotton root has very active principles. Marsh mallow (*Altheae officinalis*) used in medicine as a stimulant and in confectionery, contains *asparagin* $C_4H_8N_2O_3H_2O$ and *bassorin* $C_{12}H_{20}O_{10}$.

Okra or gumbo (*Hibiscus esculentus*) is extensively cultivated in the south and in Europe for the young mucilaginous pods which are edible. The *H. ficulneus* is used in a similar way. The fleshy red calyx of the Jamaica sorrel (*H. Sabdariffa*) is used in making jellies and sauces; the fiber makes good cordage material.

The wood of the Cuba bast (*Hibiscus elatus*), native to the West Indies, produces a timber of greenish color used in cabinet work. The lace-like inner bark is used for wrapping and is known as lace bark. From the fiber of *H. tiliaceus* a strong paper can be made very cheaply. This is also used by the natives of the Pacific Islands in making ropes.

Fibers are obtained from *Hibiscus tiliaceus, H. cannabinus, Arena lobata, Abutilon indicus, Sida retusa* and *Napaea laevis.* A beautiful wood is derived from the magar (*Thespesia grandiflora*) of Porto Rico, the color being red when fresh, black when dry. The hollyhock (*Althaea rosea*) is well known in cultivation, as are some species of the genus *Abutilon* and the poppy mallow (*Callirhoe involucrata* and *C. triangulata*).

Chorisia of eastern South America furnishes a soft fiber. The seeds of *Pachira macrocarpa* indigenous to Brazil contain a valuable oil resembling that found in cacao; kapok oil is obtained from the seeds of *Eriodendron anfractuosum.* Musk seed is obtained from *Hibiscus abelmoschus* of the East Indies and is used in perfumery. The *Malva moschata* of Europe produces a similar odorous product. The cheeses or dwarf mallow (*M. rotundifolia*) is a troublesome weed in gardens, waste places and barnyards. *Saponin* is found in the roots of *Sida jamaicensis* and *Hibiscus Sabdariffa.* The *Sida paniculata* is used as an anthelmintic. The ripe capsules of Queensland hemp (*Sida rhombifolia*) causes the death of fowls that feed on it.

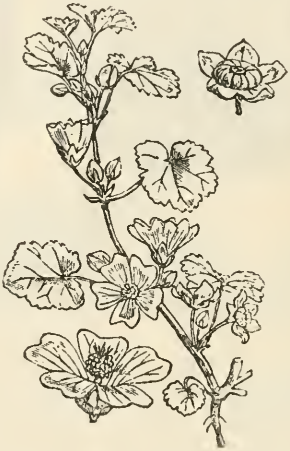


Fig. 352. Dwarf Mallow (*Malva rotundifolia*). (After Fitch.)

Key for Malvaceae

Flowers involucrate.
  Flowers small; seed solitary and not covered with cotton......2 Malvastrum.
  Flowers large; seed covered with cotton....................1 Gossypium.
Flowers not involucrate ....3 Abutilon.

Gossypium L. Cotton

Herbs, shrubs, or rarely trees from 2-10 feet high; leaves alternate, palmately veined, and lobed, stipulate; involucre of 3 heart-shaped leaf-like bracts; flowers large, regular, white or whitish; sepals 5; petals 5; stamens numerous; anthers borne along the outside of the tube of the filaments; ovaries 3-5-celled, as many as the cells of the pod; seeds numerous bearing cotton. The description of one species only is given below, the Sea Island cotton (*G.barbadense*), cultivated in Florida and along the Gulf Coast. Tree Cotton *G. arboreum* is cultivated in the tropics. The fiber is long, silky and an inch or more in length. But little is produced, its use being restricted, it is said, to making thread for turbans for the priestly class.

Gossypium herbaceum L. Common Upland Cotton

An annual, 3-6 feet high; leaves with 5 short and roundish lobes; flowers large, pale yellow, turning rose color; seeds covered with cotton. Prof. L. H. Dewey thinks that our upland cotton should be referred to *G. hirsutum* (*G. herbaceum*), which is a native of Mexico.[1] The crop in India, according to Dr. H. J. Webber is derived chiefly from *G. herbaceum,* and in Egypt, the crop is obtained chiefly from *G. barbadense.* In warm climates, cotton is a perennial. Cotton was cultivated long before the Christian era. It is one of the most important crops of the world. Dr. Webber states that in 1792 the crop was 60,000 bales; in 1820, 6,000 bales; in 1860, the product increased to 4,483,311 bales, reaching 8,547,468 bales in 1892, and in 1904, 13,693,279 bales. In a single century, from 1804 to 1904, the crop increased from 130,000 bales, valued at $13,000,014, to 13,693,279 bales valued at $557,147,306. In the early history of cotton cultivation, the seeds were not valued at all. Growers were troubled to know how to get rid of them. But in 1904 the seeds alone were valued at $90,258,227.86, making the total value of that year's crop, unmanufactured, $647,405,534.51.

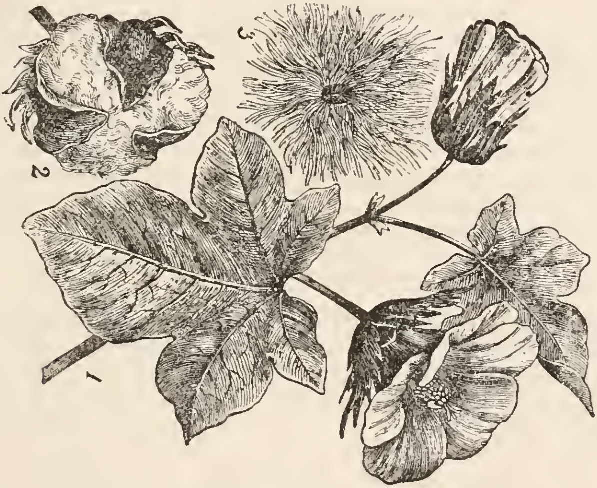


Fig. 353. Cotton (*Gossypium herbaceum*): 1, a plant with flowers and leaves; 2, a cotton boll; 3, seed. (Strasburger, Noll, Schenck and Schimper.)

Distribution. Commonly cultivated in the Southern States.

Poisonous properties. The root is commonly used in the south and tropical countries to produce abortion. Dr. Johnson says:

> Cotton acts as an abortifacient. Its action upon the uterus is similar to that of ergot, and it is used instead of the latter in cases of uterine inertia during parturition, and in amenorrhoea, dysmenorrhoea, and scanty menstruation. Whether its action upon the system at large be similar to that of ergot is unknown but worthy of investigation.

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* As to the botanical statues of the different species of the genus *Gossypium*, the following papers should be consulted: L. H. Dewey Cyclopedia of Agrl. 2: 281; Advance article on cotton by Webber in an earlier part of the same work; G. Volkens, Die Nutzpflanzen Togos Notizblatt König., Bot. Garten Berlin, App. 22, No. 2, p. 60; O. F. Cook, Origin of the Hindi Cotton Cir. Bur. Pl. Ind. 42. (This last paper gives some of the literature); Watt. St. George, The Wild and Cultivated Cotton Plants of the World, London, 1907.

The fact that the bark of cotton root should be possessed of such active properties is an interesting and suggestive one, for it affords the only instance of specific virtues attributed to a plant of the order *Malvaceae*. It will be noted that it is only the bark of the root that possesses these properties, all of the other parts of the plant partaking of the bland character of the order—the seeds especially, which not infrequently possess the most active principles of plants, in this instance yielding a bland oil which is largely used as an adulterant of olive oil. Now in an order of plants of such strongly marked characteristics as the *Malvaceae*, the discovery of striking properties in any individual should stimulate investigation of other related individuals, for it may reasonably be assumed that investigation which starts with a rational clue will be more fruitful in results than if conducted entirely in a haphazard manner. Cotton seed is often injurious to animals.

In Friedberger and Fröhner's Veterinary Pathology, Capt. Hayes writes as follows:

> Only young animals are usually affected. They display disorder of digestive and urinary apparatus: tympanites, diarrhoea (afterwards bloody), haemorrhage from the urinary organs, albuminaria, strangury and paralysis of the bladder. Duration is variable. Autopsy reveals in the acute form haemorrhagic gastro-enteritis, opaque swelling of the liver and kidneys, oedema of the lungs, dark red urine, collection of liquid in the cavities of the body. There is no enlargement of the spleen.

The liver is opaque and swollen. In chronic cases only, one finds general emaciation and dropsical phenomena. In dairy cows it induces garget and mammitis. Cotton seed oil cake contains a poisonous principle *ricin*.

The investigations Prof. M. B. Hardin of South Carolina made in 1892 indicated the presence of meta and pyrophosphoric acid in cotton seed meal. He suggested that these acids are poisonous. Dr. Crawford of the U. S. Dept. of Agrl. has recently investigated the subject and concludes that the pyroprosphoric acid is toxic. The seed from upland cotton is more toxic than the Sea Island. The toxic effect may be increased by heating; when the temperature rises high, this is due to the corversion of the orthophosphoric acid into the pyro form. The investigations of Dr. Crawford are very important.

Malvastrum Gray

Herbs with entire cordate or divided leaves; flowers solitary or racemose, short pedicelled; involucrate, or none; calyx 5-cleft; petals 5, notched at the end or entire; styles 5 or more; stigmas capitate; carpels indehiscent or imperfectly 2-valved; seed kidney-shaped. About 75 species, natives of America and South Africa.

Malvastrum coccineum (Pursh.) Gray. False Mallow

A low hoary, perennial herb, with dense silvery stellate pubescence; lower leaves pedately 3-5 parted; flowers small, red, in dense, short racemes, usually without bractlets; calyx lobes shorter than the pink-red petals; carpels 10 or more, indehiscent, rugose, and usually 1-seeded.

Distribution. From South Dakota to Texas, New Mexico to British Columbia.

Poisonous properties. Has been suspected of being poisonous, but there is no evidence to support this view. Profs. Chesnut and Wilcox regard the plant as non-poisonous. Some ranchers consider that it may be the cause of loco poisoning.

Abutilon (Tourn.) Mill. Indian Mallow

Herbaceous or shrubby plants, or in the tropics, trees with soft, pubescent leaves and stems; involucral bracts none; calyx 5-cleft; petals 5; styles 5 or more; carpels 2-valved, 2-9 seeded; seeds reniform. About 90 species in tropical or warm temperate regions. Many of the species are under cultivation.

Abutilon Theophrasti Medic. Velvet-leaf

A stout, strongly-scented annual, 2-4 feet high, with tough, fibrous stems; leaves roundish, heart-shaped, tapering to a point, velvety; peduncles shorter than the petioles; flowers yellow; carpels 12-15, pubescent, opening at the apex; each valve beaked by a slender awn.

Distribution. Common in the northern states. Naturalized from India.

Poisonous properties. It is reported as poisonous; the strong odor is so very objectionable that it is not likely that much of the plant will be consumed by stock.

PARIETALES

Herbs, shrubs, or trees; flowers generally complete, perfect and regular or in some cases irregular; sepals distinct or united, imbricated or convolute; petals nearly always present and distinct; stamens mostly numerous; ovary compound superior or inferior in some; placentae mostly parietal. The order includes a number of important families. *Caricaceae* contains the pawpaw (*Carica Papaya*) the edible fruit of which is from 6-10 in. long; of yellow color and contains the alkaloid *carpain* $C_{14}H_{25}NO_2$, acting similarly to digitalis, and a glucoside *caricin*; it also contains the enzyme *papain*, which resembles *trypsin* in its proteolytic action, converting animal proteins into proteoses forming peptones. This does not occur in vegetables. These changes do not go on in acid and alkaline substances, but act best in a neutral medium. The most active changes occur best when the medium is from 53 to 40 degrees C. A similar ferment occurs in the leaves of *Carica quercifolia* of Argentina. *Caryocaraceae* includes gamboge (*Garcinia Hanburyi*) a cathartic; the mammey apple (*Mammea americana*) cultivated in the West Indies; the *Calophyllum Calaba* which furnishes the Calaba balsam, the mangosteen (*Garcinia Mangostana*) of the Moluccas, widely cultivated in the tropics. The *Dipterocarpaceae* includes the genus *Dipterocarpus,* which furnishes resin, and shorea, furnishes Chalia resin. "Piney resin" is obtained from *Vateria* and is used as a substitute for dammar. The *Tamaricaceae* contains the ornamental *Tamarix gallica*, an excellent honey plant; the *Tamarix mannifera* from which a manna-like sugar is derived; the *Fouquiera splendens* of Mexico frequently cultivated and producing the ocotilla wax; and the *Myricaria germanica*, the twigs of which are used as a substitute for hops. *Cistacae* includes the rock rose (*Helianthemum canadense*), the pinweed (*Lechea minor*) and the *Cistus polymorphus* furnishing laudanum.

The *Begoniaceae* includes the commonly cultivated genus of *Begonia* with 550 species. The *Bixaceae* includes *Bixa Orellana* which furnishes the Annatto used to color butter, silks, etc. In the *Canellaceae,* is *Canella alba*, from which is obtained the Canella bark of commerce, often called wild cinnamon and which is used as a condiment in the West Indies and Florida where it is a native.

The family *Flacourtiaceae* of the tropics includes a number of plants like *Gynocardia odorata* of India, *Hydnocarpus venenata* and the *Kiggelaria africana* of Ceylon, the seeds of which contain *hydrocyanic* acid. The cocos oil is obtained from *Myroxylon* and is used in perfumery. The *Casearia esculenta* of Asia and Australia is a purgative. The family *Turneraceae* contains a few medicinal plants. A variety of *Turnera diffusa* furnishes a laxative. The *Datisca cannabina* of Southern Europe belongs to the family *Datiscaceae* and furnishes the yellow coloring matter *datiscin* used to dye silk; some members of the family *Dilleniaceae* are cultivated for their beautiful flowers. The *Marcgraviaceae* are occasionally cultivated and the *Marcgravia umbellata* is used in medicine; the family also contains the "Bitter-sick tree" *Datisca glomerata* which is used, according to Chesnut, by the Indians of California to poison trout.

Families of Parietales

Calyx gamosepalous.
  Throat of the calyx with a fringed crown..................Passifloraceae.
  Throat of calyx without a crown ....Loasaceae.
Calyx with sepals; sepals generally distinct and persistent.
    Flowers irregular ....Violaceae.
    Flowers regular.
      Trees or shrubs; leaves alternate.........................Theaceae.
      Herbs or shrubs; leaves opposite or whorled.........Hypericaceae.

THEACEAE. Tea Family

Trees or shrubs with alternate simple leaves without stipules; flowers large, showy, regular, hypogynous, mostly axillary; sepals 5, or rarely more, often with 2 bracts; petals 5 or rarely more; stamens more or less monadelphous; anthers 2-celled; ovary 2-5-celled; ovules 2 or more in each cell; fruit a woody capsule; embryo large; endosperm scant. A small order of 160 species, mostly native of warm regions. The tea plant (*Camellia Thea*) is native to Assam, and extensively cultivated in Japan, China, and India. The *Thea sinensis* with the varieties *viridis* and *bohea* furnish tea. Successful attempts at cultivation have also been carried on in South Carolina. The black and green teas come from the same species. Tea is an important article of commerce in all civilized countries, Russia, England and the United States using large quantities.

The active principle found in tea is *caffein* or *thein* $C_8H_{10}N_4O_2$, a feebly alkaline, bitter alkaloid which is a cerebral and cardiac stimulant. Thea also contains the alkaloid *caffeidin* $C_7H_{12}N_4O$; *theophyllin* $C_7H_8N_4O_2+H_2O$; *theobromin* $C_7H_8N_4O_2$, which is a bitter alkaloid having a physiological action similar to that of *thein.* The principle alkaloid *thein,* or *caffein,* as it is known, is a feebly basic, proximate substance, obtained from the tea plant, from the dried seeds of coffee, and from some other plants. This alkaloid has no particular action upon the digestive tract, unless it is used in large quantities, when it may cause gastro-intestinal irritation. *Caffein* increases the blood pressure, causing the heart to beat more forcibly and rapidly. It is a certain and direct stimulant. It produces wakefulness and restlessness and stimulates the reasoning and imaginative faculties in man. In the lower animals, according to Dr. Winslow, it often causes "the most intense cerebral excitement and mania when given in large doses, — produces restlessness, increased reflex excitability and convulsions in the lower animals." Dr. Winslow states further that *caffein* is a spinal and muscle poison to the frog, and tetanic convulsions occur in the batrachian similar to those produced by *strychnin,* but there is also muscular rigidity. The symptoms of poisoning in dogs, cats, and mammals generally, are restlessness, occasionally vomiting in dogs, rapid breathing, primary reduction followed by rise in temperature, clonic or tonic convulsions, muscular weakness, and general paresis. Tea contains some *saponin*, but it is found especially in *Thea Sassanqua* of China and Japan and a saponin-like substance called *assamin* occurs in *T. assamica*; the flowers of the former species are used to flavor tea. The flowers and leaves of *T. Kissi* are used as an insecticide.

The Camellia (*C. Hongkongensis*) is a well known evergreen shrub cultivated in green houses. Two east North American genera of the order are *Stuartia* and *Gordonia*.

The leaves of many plants are used as substitutes for tea, among them are: Gromwell (*Lithospermum officinale*), Willow herb (*Epilobium angustifolium*), Willow (*Salix*), Ash (*Fraxinus* sp.), European Mountain Ash (*Pyrus Aucuparia*), Mulberry (*Morus alba* and *nigra*), Coffee (*Coffea arabica*), Camellia (*Camellia hongkongensis*), Cherry (*Prunus spinosa*), Rose (*Rosa canina*), Strawberry (*Fragaria vesca* and *virginiana*), Meadow Sweet (*Filipendula ulmmaria*), Wistaria (*W. chinensis*), Hydrangea (*H. Hortensia*), Boxelder (*Negundo aceroides*), Oak (*Quercus*), Akebia (*A. quinata*), Blueberry (*Vaccinium Myrtillus*). In Russia the leaves of *Vaccinium* and *Arctostaphylos* are made into tea. In North America, in addition to plants previously named, the leaves of Labrador tea (*Ledum latifolium*), New Jersey tea (*Ceanothus americanus*), Oswego tea (*Monarda didyma*) and Mexican tea (*Chenopodium ambrosioides*), are frequently used.

In South America the following are tea substitutes: *Lippia pseudothea, Stachytarpheta jamaicensis, Psoralea glandulosa, Myrtus Ugni, Symplocos Alstonia, Capraria biflora, Angraecum fragrans,* and *Eritrichium gnaphaloides.*

In China *Sageretia theezans* is used as a tea substitute, and in Australia various species of *Myrtaceae* are used for the same purpose.

HYPERICACEAE. St. John's-wort Family

Herbs or shrubs or occasionally small trees with opposite entire punctate, dotted leaves, without stipules; flowers solitary or cymose, paniculate, perfect and regular; sepals and petals 4 or 5, sepals persistent; stamens numerous, hypogynous in 3 or 5 sets; ovary 1-7-celled, and as many styles; pod 1-celled with 2-5 parietal placentae; seeds numerous, small; endosperm absent. About 275 species, some cultivated for ornamental purposes. Kalm St. John's-wort (*H. Kalmianum*) of the lake region, shrubby St. John's-wort (*H. prolificum*) and the great St. John's-wort (*H. Ascyron*) are desirable species for ornamental planting. The *H. perforatum* and other species yield a yellow dye. The *Vismia viridiflora* of Guiana yields a resin called American gamboge.

Hypericum (Tourn.) L. St. John's-wort

Herbs or shrubs with opposite punctate leaves; flowers borne in cymose clusters; sepals 5; slightly unequal; petals 5, yellow; stamens numerous, distinct or somewhat united in sets; fruit a capsule 1 to 5-celled; seeds numerous. About 200 species, of wide distribution.

Hypericum perforatum L. Common St. John's-wort

A perennial, much branched herb, with numerous sterile shoots at the base; leaves sessile, oblong or linear, black, punctate dots; flowers borne in cymose clusters, yellow sepals shorter than the yellow and black-dotted petals; stamens many in 3-5 clusters.

Distribution. Common in the eastern states, rare west of the Mississippi and in the southern states.

Hypericum punctatum Lam. Spotted St. John's-Wort

Herbaceous, perennial, 1 or more feet high; copiously marked with black, pellucid dots; leaves sessile, oblong or ovate-lanceolate; cymes terminal, many-flowered; flowers crowded; petals pale yellow, large, longer than the oblong sepals; styles mostly not longer than the pods.

Distribution. In moist soil, Maine and Ontario to Minn., Florida, Kansas and Texas.

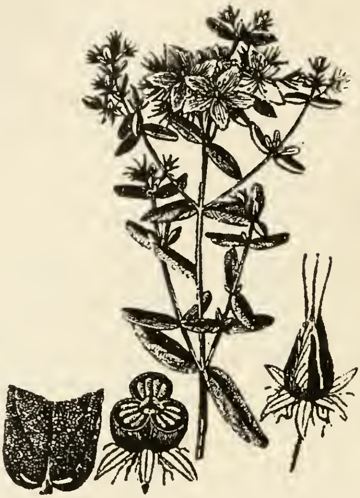

Fig. 354. St. Johns-wort (*Hypericum perforatum*). Flowering branch, fruit, section of fruit, part of leaf. Contains an oil and an acrid resin. (From Vesque's Traité de Botanique.)

Hypericum Ascyron L. Great St. John's-wort

Large stems, from 2-5 feet high, branched, 2-4-angled; leaves oblong, partly clasping; petals narrowly obovate; cymes terminal, few-flowered; flowers large, bright yellow; stamens in 5 sets; styles 5, united below; capsules ovoid, 5-celled; seeds small, numerous.

Distribution. From Vermont, Canada and Manitoba to Kansas, Illinois, eastward, also found in Europe and Asia.

Poisonous properties. It is believed that, where the plant is common, it is poisonous. It is said to cause eruptions on cows' udders and on the feet of white-haired animals. A writer in Breeders' Gazette reports the former species as poisonous. Prof. Chesnut says:

> This species and the spotted St. John's-wort (*H. masculatum, H. punctatum*), were brought into the Department by Dr. G. W. Bready, from Norwood, Md., who stated that five horses were poisoned in May, 1898, by eating meadow hay which contained nearly 50 per cent of these plants. One horse died from the effects of the poison, and two were killed to prevent their further suffering.

The oil of Hypericum is obtained from the European St. John's-wort (*H. perforatum*) and is apparently found in the black dots of the petals and fruits. The resin, however, found in the plant, is acrid and slightly bitter. The physiological action of the St. John's-wort is: mental depression and exhaustion; vertigo and confusion of the head; dilation of the pupils, and increased heart action.

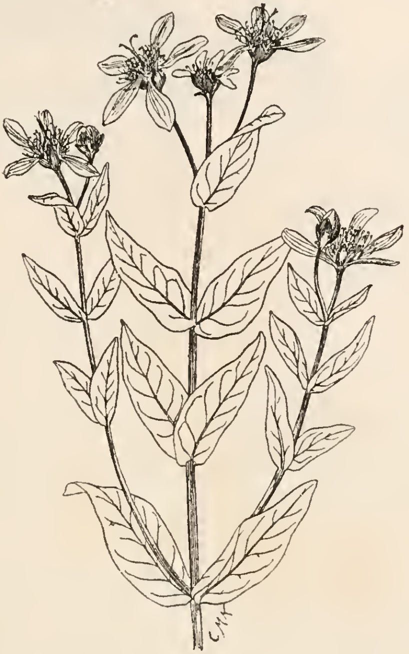

Fig. 355. Great St. John's-wort (*Hypericum Ascyron*). (Charlotte M. King.)

VIOLACEAE. Violet Family

Usually herbs or rarely shrubs or trees, caulescent or acaulescent, with alternate, simple, entire or lobed leaves with stipules; flowers mostly irregular; sepals 5; corolla of 5 petals, 1-spurred, hypogynous; stamens 5, short, filaments broad and flat, often cohering with each other around the pistil; ovary simple, 1-celled, with 2 parietal placentae; fruit a capsule; seeds anatropous. About 300 species, of wide distribution. The best known is the pansy (*Viola tricolor*) running into numerous varieties, native to the Old World. It is sometimes used in skin diseases. The fragrant violet (*V. odorata*) is also frequently cultivated. Some of our native species are very handsome. Among these are the bird-foot violet (*V. pedata*), common in gravelly soils from Maine to Florida, west to Minnesota and Iowa and the *V. pedatifida* from Illinois to Kansas and Minnesota. Our most common eastern yellow violet is *V. pubescens*; the *V. Nuttallii,* also yellow, occurs from central Kansas westward. The white Canadian violet (*V. canadensis*) is common in the north and in the mountains. *V. striata* is common from the New England states to Minnesota and Missouri. The white-flowered violet (*V. blanda*) occurs in swamps. Brazilian ipecac is

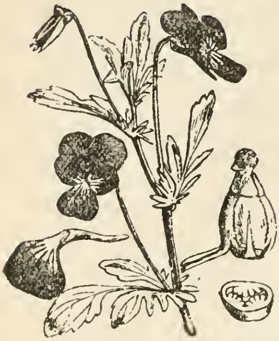

Fig. 356. Pansy Violet (*Viola tricolor*). Possesses emetic qualities. (After Fitch.)

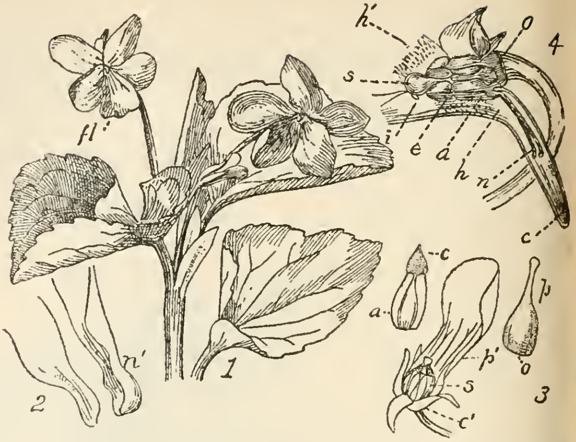

Fig. 356a. 1-2, Yellow violet (*Viola pubescens*). 2, Spurred petals. 3-4, Pansy. c, Caylx. p, Pistil. a, Another spur.

derived from *Hybanthus Ipecacuanha.* The sweet pulp of the fruit of the *Leonia glycycarpa* of Peru is eaten by the natives; the fruit being about the size of a peach. We shall describe only a single species characteristic of the order, viz., the common pansy, which is a common weed in the South.

Viola L.

Acaulescent or leafy-stemmed herbs; annual or perennial; flowers solitary or rarely 2, smaller than the cultivated pansy; sepals 5; petals 5; unequal, the lower spreading at the base; stamens 5; anthers erect, united; in many of the species early blossoms are conspicuous, the later being cleistogamous.

Viola tricolor L. Heart's-ease.

Plant usually smooth; stem angled, branched; leaves roundish, or the lower oval, often heart-shaped; petals variable in color or variegated, yellow, whitish, violet-blue, and purple.

Distribution. Common in dry or sandy soil from New England to Kansas, especially southward. Also common on the Pacific Coast.

Poisonous properties. The substance *violin,* an acrid, bitter principle, has been extracted from the above species, and also is found in some of our native varieties. It is a pale yellow, bitter powder. The substance *violaquercitrin* $C_{42}H_{42}O_{24}$, is a coloring matter which is found in the pansy. The emetic effect of violets is well known and is supposed to be due to the presence of *violin.* Dr. Millspaugh states:

> The most characteristic symptom of its action is an offensive odor of the urine, like that of the cat. The pains caused by this drug are of a stitching character, while its action seems spent almost entirely upon the skin, and the male sexual organs. On the skin it causes burning, stinging, and itching, followed by breaking down of the tissues into either squamous spots, or any grade of incrusted eruptions; the eruption pours out a thin yellow fluid.

Dr. Schaffner states that the sweet violet is somewhat poisonous, the underground parts being emetic and cathartic.

Dr. Rusby says:

> Many violets are noted for their ipecac properties, yielding a glucoside called *violin* long confused with the *emetin* yielded by ipecac. They may be classed among the emetico-cathartics, and a large quantity might easily be productive of serious results to a child.

According to Spatzier, the seeds of violet contain *myrosin* and a glucoside.

PASSIFLORACEAE. Passion Flower Family

Shrubs or herbs climbing by axillary tendrils; leaves alternate, simple, generally 3-lobed; flowers perfect, regular, axillary; calyx tube persistent; petals usually 5, inserted on the throat of the calyx tube, which is fringed with a crown of a double or triple row of long, slender fringe; stamens 5, monadelphous, enclosing the stipe of the ovary; pistil 1; ovary with 3-5 parietal placentas; styles 1-5; fruit a berry or capsule, usually many-seeded.

A small family of about 300 species of warm and tropical regions. The common blue passion flower (*Passiflora caerulea*) of South America is frequently cultivated. The *P. edulis*, native of the West Indies, about the size of a hen's egg, is eaten; the grandilla (*P. quadrangularis*) producing a fruit 6 inches long, often weighs 3 pounds. The common maypop of the South (*P. incarnata*) with a fruit about the size of a hen's egg, is eaten. This species and the *P. lutea* are sometimes weedy. The Tacsonia yields *hydrocyanic* acid.

LOASACEAE. Mentzelia Family

Herbs with rough, often stinging hairs, leaves without stipules; flowers regular, perfect, whitish, yellow or reddish; calyx tube adherent to the ovary, lobes 4-5; petals 4-5, inserted on the calyx; stamens numerous; pistil 1, usually 1-celled, with 2 or 3 parietal placentae; fruit a capsule, 1-celled with the persistent lobes of the calyx; endosperm scant.

About 200 species, nearly all native to North America. The Kissenia, however, being found in Africa. Species of the genus *Blumenbachia* (*B. grandiflora*) produce pretty flowers and are cultivated in greenhouses. The *Mentzelia gronoviaefolia*, from Mexico and Texas, is also cultivated. The leaves of *Mentzelia ornata* and other species produce hooked hairs which are often annoying to man.

Mentzelia (Plumier) L. Mentzelia

Herbs with erect stems, alternate leaves with barbed hairs; flowers usually showy, terminal, solitary or clustered; calyx tube cylindrical or club-shaped, lobes persistent; petals 5-10, regular, spreading, falling, usually turning black in drying; stamens numerous, inserted on the throat of the calyx tube; styles 3, more or less united; capsule dehiscent at the summit, many-seeded; seeds flat. About 50 species, American, chiefly west of the Mississippi river.

Mentzelia ornata Torr. and Gray. Showy Mentzelia

A rough herb from 1-2 feet high; leaves oblong-lanceolate, deeply toothed or pinnatifid; flowers solitary, much larger than the lanceolate calyx lobes; petals 10, yellowish-white, 2-3 inches long; capsule 1½-2 inches long; seeds numerous, with narrow margin.

Distribution. Northwestern Iowa to Dakotas to Central Kansas and Texas.

Injurious properties. The hooked hairs of the plant cause the leaves to stick to sheep, clothing, etc. Prof. Goodale of Cambridge, Mass., is quoted by

Dr. White, in his Dermatitis Venenata as saying: "Mentzelia has grown in our garden, and has always been amazingly irritating to us all. Some species are even said to have stinging hairs." The writer has had considerable experience in collecting these species in the West, and he has learned from experience that the barbed hairs are quite irritating. Dr. Halsted states that *M. oligosperma* has the same properties. This plant is frequently cultivated.

OPUNTIALES.

Fleshy plants, usually spiny with jointed stems; leaves small; flowers mostly solitary, regular; calyx tube adnate to the ovary with a many lobed limb; stamens numerous, inserted on the throat of the calyx; filaments filiform; ovary 1-celled; ovules numerous; fruit a berry. Contains the important family *Cactaceae.*

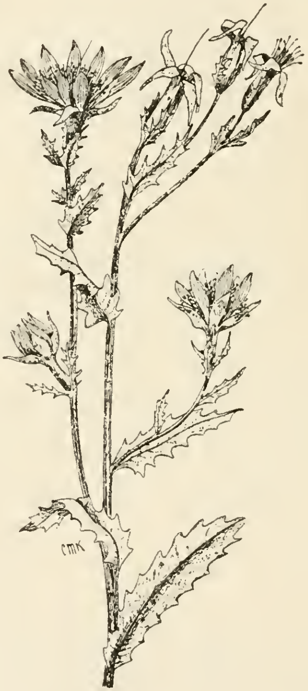

Fig. 357. Showy Mentzelia (*Mentzelia ornata*). The hispid hairs of this plant produce mechanical injuries. (Charlotte M. King.)

CACTACEAE. Cactus Family.

Fleshy plants, leafless or with small leaves; stems flattened, columnar or globular, generally abundantly spiny; flowers solitary, sessile, perfect; calyx tube adnate to the ovary, limb many lobed; petals numerous, imbricated in several rows, mostly distinct; ovary 1-celled; ovules numerous, anatropous, borne on several parietal placentae; fruit a 1-celled berry or a dry fruit; endosperm wanting or copious.

About 1000 species, chiefly in the regions west of the Missouri river. Many species occur in the arid regions of the southwest. One of the most interesting is the giant cactus (*Cereus giganteus*) of Arizona, with fluted columns 50 or 60 feet high. The common night blooming cereus (*C. grandiflorus*), with white flowers opening at night, is well known in cultivation. The most commonly cultivated species is *C. speciosissimus*, with crimson red flowers that open during the day. The old man cactus (*C. senilis*) is cultivated because of its long white hanging hairs. Species of the genus *Echinocactus*, with stem of many ribs, are often cultivated, the most common being *E. texensis* of southern Texas and Arizona and the *E. Ottonis* of Brazil. A very good quality of leather has been produced from *E. Wislizeni* and *Cereus giganteus*. Species of *Mamillaria* with tufted stems covered with nipple-shaped tubercles, are often found in cultivation. The *Epiphyllum truncatum*, from Brazil, with flattened, leaf-like stems and flowers 2-3 inches long, and the *Phyllocactus,* native to South America and Mexico, are also cultivated. The large genus *Opuntia,* of over 150 species, is entirely American. The *O. vulgaris,* Mill, naturalized in southern Europe, extends from southern New England west and south; *O. Rafinesquii* extends from Michigan west; and *O. polyacantha* from Wisconsin westward. Several Mexican species are cultivated. The Indian pear or prickly pear (*O Ficus-Indica*) of the West Indies and South America, produces an edible fruit. Extensively naturalized in North America, South Europe and Asia and as hedge plants. It grows on the lava slopes of Mount Aetna, converting the lava into soil. The cochineal plant (*Nopalea coccinellifera*) a native of Mexico, is cultivated as the host of the cochineal insect, from which a scarlet carmine dye is obtained. *O. Tuna, O. Dillenii* and *Pereskia* also act as hosts of the same insect. The fleshy stem of some *Opuntias,* after the spines are removed, are used as stock food. The berries of some species like *Opuntia Larreyi* which belongs to the *O. Ficus-Indica* group, *O. Striptacantha* and *Echinocereus stramineus*, etc., are eaten. A recent paper by Hare and Griffith described many details of their uses. The Mexicans call them tunas; an alcoholic drink is also made from the fruit. Some species are used as soil binders in Texas and elsewhere.

Injurious properties. The barbed trichomes penetrate the flesh and are difficult to remove. Death of animals has been caused by "hair balls" phyto-bezoars from them being formed in the stomach. Dr. William Trelease, who had occasion to examine the "hair balls" produced in some Mexican animal, gives the following account of this phytobezoar:

"The hair balls were a little over 3½ inches in diameter and weighed 7½ ounces. One ball was probably 4 inches in diameter." It was stated by the physician who sent them to Dr. Trelease that 16 such balls had been taken from the stomach of a bull at the Hacienda de Cruzes; it appears that the chief food of cattle at this time of the year consisted of Opuntias, and that the particular animal in question being allowed to roam at large, sought such food as could be found. These phyto-bezoars were brown in color, "and in appearance somewhat suggest felt or rubbed sole leather, and on examination prove to be composed, aside from the small nucleus at the center, of the barbed hairs with which the pulvini of the Platopuntias are armed. To the barbs with which these hairs are covered is due their power of felting together, and there is every indication that, starting about some small nucleus of vegetable fiber, they have been compacted into the dense, felty texture by the visceral movements of the animal, to which, causing friction against one another, their perfectly round form is attributable." As is well known, the *Opuntias* produce spines and two kinds of trichomes. In the *Cylindropuntias*, each spine is invested by a deciduous sheath, "which is downwardly barbed, so that a person or animal brushing carelessly against a plant is certain to remove some of the barbed sheaths." In the *Platopuntias*, to which the ordinary flat-stemmed prickly pears belong, the spines, when present, are destitute of such a sheath. The protection to the plant is afforded simply because of their rigidity and pungency. The spines have their origin in pulvini, and in this particular genus of cacti are coated with delicate flexible hairs, divided into partitions. These hairs are lightly attached to the epidermis of the plant, so that when the pulvinus is touched they are almost certain to be removed in considerable numbers. The points of the stiffer hairs penetrate the skin, the barbs with which they are closely beset preventing their ready withdrawal. Dr. Trelease, in summing up the injurious effect of cacti, says:

> It is a frequent practice in Texas to cut the branches of cacti which are fed to stock into half-inch lengths. In this way, every one of the obliquely set longer spines of *Opuntia Engelmanni* (and of some other species which are so used) is almost certain to be cut off, so that the danger from the spines is removed. This treatment, however, does not destroy the barbed hairs of the pulvini, of which the bezoars under consideration are composed. It is also the practice, in some places, to roast the fragments as a means of completely removing the spines and barbed hairs, but this is objected to by some feeders, because the roasting has been asserted to add to the laxative properties of the cactus. Where some such treatment has not

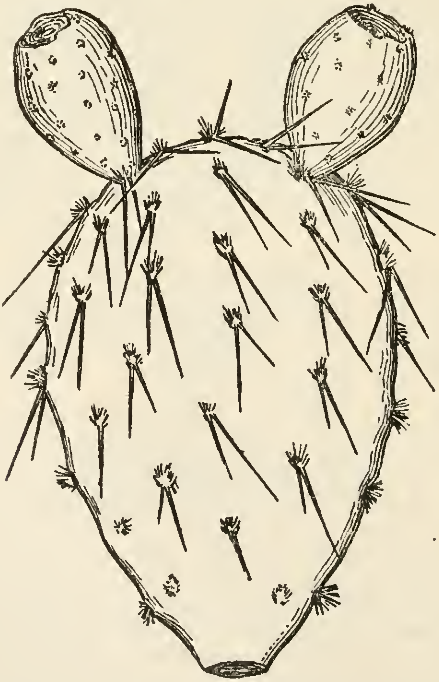

Fig. 358. Prickly Pear (*Opuntia Engelmanni*), from the barbed trichomes of which phytobezoars are sometimes formed. (U. S. Dept. Agr.)

been resorted to, injury to the animals not infrequently results; and in the bulletin referred to, Dr. Vasey gives a number of instances in which cattle have died from an accumulation of spines in the mouth and stomach, an effect somewhat comparable with that caused by the awns of *Hordeum* when cattle feed upon these.

The eating of the fruit of some species of *Opuntia* produces diarrhoea.

Under the name of Pellate (*Anhalonium sp.*), the Indians of the Rio Grande Valley of Mexico have for ages used the tops of this plant which they commonly call "mescal button" or "mescal bean." The use has extended to Indians in Oklahoma and Indian Territory and, it is said, to the Tama Indians of Iowa. The Kiowa Indians use 14-15 grams (4-5 buttons) to produce the peculiar sensations. The so-called mescal beans are 1-1½ inches long and about ¼ inch in diameter, brittle when dry, but soft when moistened. They have a bitter, disagreeable taste. Prentiss and Morgan were the first to call attention to the character of the drug dried from *Anhalonium*. During intoxication, the pupils become dilated, there is muscular relaxation, the pulse is somewhat slower, there is loss of sense of time, partial anaesthesia, weakened heart action; in some nausea and vomiting, and wakefulness. In man the influence has been described as causing an incessant flow of visions of infinite beauty, grandness, and variety of color and form. Intoxication closely resembles that produced by *Cannabis indica*. Dr. Lewin found that an aqueous extract given to lower animals produced convulsions causing death by respiratory failure.

The *A. Lewinii* contains the alkaloid *anhalonin* $C_{10}H_{17}NO_1$. *mescalin* $C_{11}H_{17}NO_3$ and *anhalonidin* $C_{12}H_{15}NO_3$. The *A. fissuratum* contains *pellotin*. Although this substance, according to some authors, is inactive, it has been used as a calmative on insane patients and in many cases causes sleep to come on. The *cactin* found in some species is a cardiac stimulant. It appears also that in addition to the above species the same or allied substances occur in *A. prismaticum*, *A. Williamisii* and *A. Jourdanianum*.

Anhalonium is closely related to the genus *Cactus*. It bears a dense penicillate tuft of long soft hairs which persist above the apical region of the plant as matted wool.

According to several recent investigators, especially Kauter and Heyl, alkaloids seem to be widely present in the family *Cactaceae*. *Pectenin* is found in a species of *Cereus; pilocerein* $C_{30}H_{44}N_2O_5$, occurs in *Pilocereus Sargentianus*; the alkaloid *pellotin* $C_{11}H_{12}NN(OCH_{32})OH$, is found in species of *Anhalonium; and Lophophorin* occurs in *Anhalonium Lewinii* and allied species. The alkaloidal substances appear to the extent of 1.1 per cent in dried material. *A. Lewinii* is a cardiac and respiratory stimulant. *Saponin* also is found in several species of the family among them in *Cereus gummosus*. Quite a number of other species of the family are used in medicine. The night-blooming cereus (*Cereus grandiflorus*) contains a glucoside which acts much like *Digitalis*. The *Opuntia Karwinskiana* contains an astringent principle. Several species such as *Rhipsalis* and *Opuntia* have anthelmintic properties.

MYRTIFLORAE.

Mostly shrubs or trees. Leaves simple; flowers incomplete; calyx inferior, 4-5 lobed or entire; corolla usually wanting; stamens twice as many as the calyx lobes or fewer; ovary 1-celled; ovule 1.

Species of the genus *Cuphea* of the family *Lythraceae* are cultivated in the South as border plants; the cape myrtle (*Lagerstroemia indica*) of the East

Indies, of the same family, is a handsome ornamental shrub, the seeds of which contain a narcotic principle; Henna (*Lawsonia inermis*) yields a yellow dye which is used in Egypt and Arabia as a cosmetic for the hands.

Tannin occurs in the root of *Lythrum Salicaria*. *Cuphea viscosa* of Mexico contains a substance similar in action to *Digitalis*. The fresh leaves of *Ammannia baccifera* of India contain a vesicating substance.

The family *Lecythidaceae* contains the well known Brazil or Para nut (*Bertholletia excelsa,* and *B. nobilis*), the Sapucaya-nut from the monkey-pot tree (*Lecythis allaria*) and other species.

Narcotic and poisonous principles occur in the fruit of *Planchonia valida,* native to the Molucca Islands, and in the seeds of some species of *Lecythis.* The roots and fruits of Chinese and Japanese species of *Barringtonia* are used as fish poisons. The family *Punicaceae* contains the pomegranate (*Punica granatum*) from the orient, cultivated in green houses in the North and out of doors in California and the South for its acid fruit, which is about the size of a small apple. The bark is used as a vermifuge and is an active irritant, its medicinal properties being due to a number of alkaloids present, of which four have been isolated. The Mangrove (*Rhizophora Mangle*) belongs to the family *Rhizophoraceae.* Its wood is used in boat building. The Indian Almond (*Terminalia Catappa*) through its bark and leaves furnishes a black dye. The family

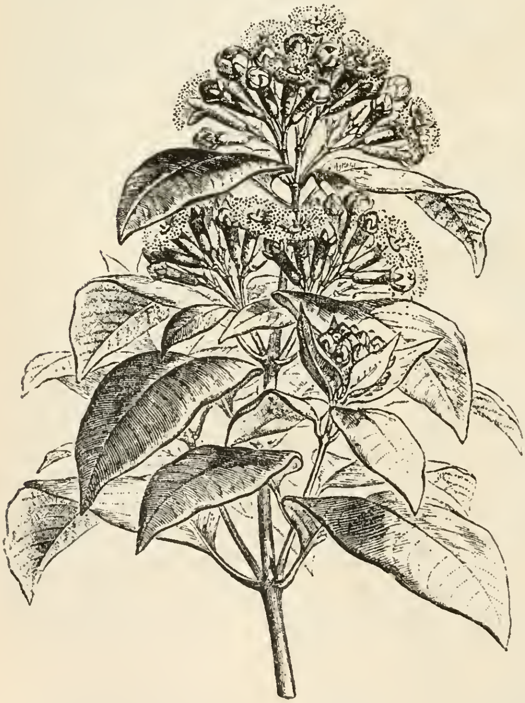

Fig. 359. Clove Tree (*Eugenia caryophyllata*). A native of the Molucca Isles. (After Faguet.)

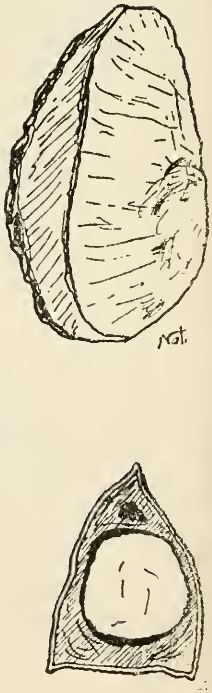

Fig. 360. Brazil Nut (*Berthollettia excelsa*). (W. S. Dudgeon.)

Myrtaceae contains the guava (*Psidium Guajava*), a most delicious fruit from which is made a jelly that is considered a great delicacy; the bay-berry (*Amomis caryophyllata*), from the dried leaves of which, when placed in water, an essential oil may be distilled which is used in the medication of rum; rose apple (*Jambosa malaccensis*) which yields an edible fruit and furnishes a material suitable for baskets, hoops, sugar casks, etc.; Jambuse berries (*Jambosa vulgaris*) cultivated in the tropics; the spices, piment or allspice, (*Pimenta officinalis*) and cloves, (*Eugenia caryophyllata*) from the Moluccas, common articles of commerce. Cloves contain an essential oil which is an excellent antiseptic and contains *caryophyllin*, $C_{10}H_{16}O$, and *eugenin*, $C_{10}H_{12}O_2$. Cajaput, (*Melaleuca leucodendron*) is an excellent stimulant containing *cajaputol*, $C_{10}H_{16}H_2O$.

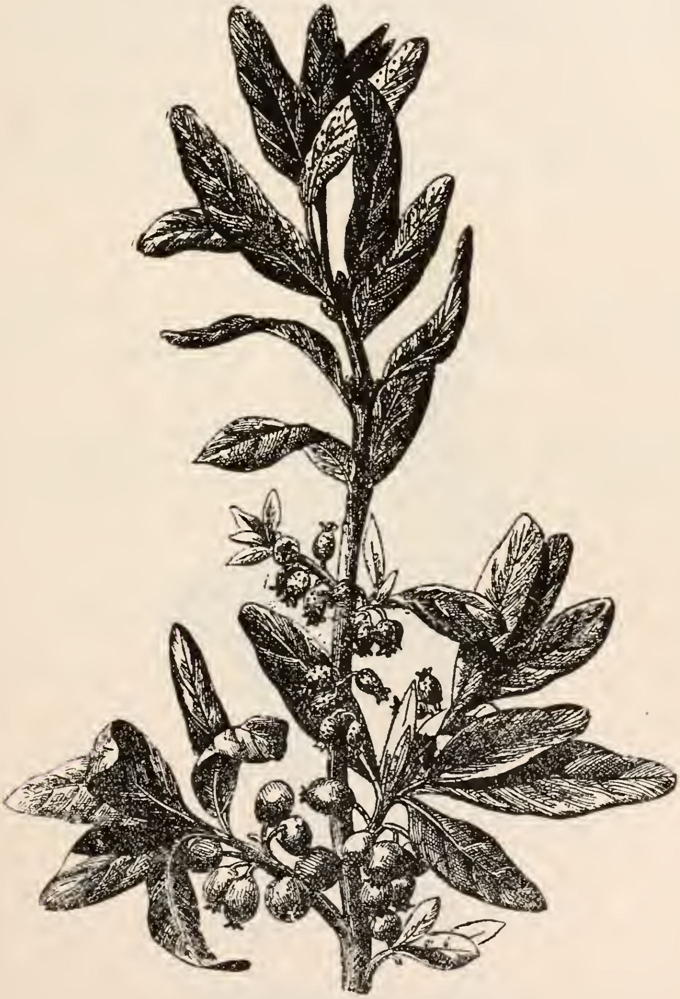

Fig. 361. Buffalo Berry (*Shepherdia argentea*). Fruit used for jellies, etc. (From American Agriculturist.)

The oil of Myrcia is obtained from the leaves of *Pimenta acris* of the West Indies and contains *eugenol* and *chavicol.* The volatile oil of Cheken (*Eugenia Chequen*) contains *cineol, pinene,* a volatile alkaloid, and a glucoside. The leaves of Myrtle (*Myrtus communis*) yield a substance used in perfumery. The Eucalypts, natives to Australia, are important timber plants, producing valuable wood for interior finishing, furniture, parts of vehicles, etc. A few species are extensively cultivated in California, of which *Eucalyptus globulus* is one of the most frequently seen. The *oil of eucalyptus* and *eucalyptol* are used in medicine, and have valuable antiseptic properties. The *E. rostrata* produces Kino. The family *Combretaceae* contains many plants rich in tannin like the bark of *Terminalia Catappa* of Asia. The fruit of Myrabalons (*T. Chebula*) is rich in tannin. The *T. fagifolia* of Brazil has cathartic properties. Some of the plants of this family are used in arrow poisons. Several plants of the family *Melastomaceae* produce edible fruits; some of them like *Tococa guianensis* yield a black dye. The only indigenous genus in the Northern States is *Rhexia.* The family *Trapaceae* contains the edible Chinese water-nut or water chestnut (*Trapa natans*) naturalized in New England and New York. The family *Halorrhagidaceae* contains several water plants of common occurrence like the water milfoil (*Myriophyllum spicatum*), the mare's-tail (*Hippuris vulgaris*) and the mermaid-weed (*Proserpinaca palustris*).

Shrubs.

Key to Families of Myrtiflorae

Leaves green; seeds pendulous	Thymelaeaceae
Leaves silvery, scurfy; seed erect	Elaeagnaceae
Herbs or rarely shrubs; calyx tube almost wholly adnate	Onagraceae

Elaeagnaceae. Oleaster Family.

Shrubs or small trees; leaves silvery, scurfy; flowers perfect or dioecious; calyx regular, simple, colored; calyx tube becoming pulpy and berry-like in fruit, strictly enclosing the achene; seed erect, ascending. A small order of 20

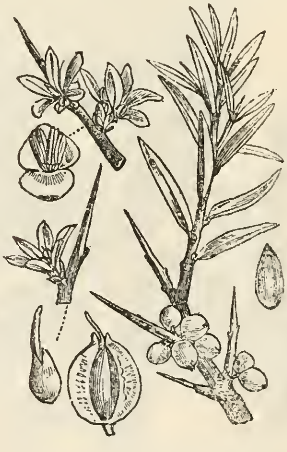

Fig. 362. Sea Buckthorn (*Hippophae rhamnoides*). Produces a berry. (After Fitch.)

species and 3 genera. The buffalo berry is well known. The *Shepherdia argentea* is a thorny shrub from 5-18 feet high, from Western Iowa and westward, the acid fruit of which was much used in early days for jams, jellies and pies. The Russian oleaster or wild olive (*Eleagnus angustifolia*), a well known ornamental shrub, adapted especially to the North West, is hardy and handsome. It has spiny branches which bear fragrant flowers. The wood is durable and makes an excellent post. The Goumi (*E. multiflora*) of Japan, produces edible fruit. The *E. hortensis* formerly included two species, the *E. angustifolia* and *E. orientalis.* Prof. Hansen has introduced the edible form of the shrub into the Northwest. The Arabs dry the berries and make a kind of cake. The *Hippophae rhamnoides,* an ornamental plant from Europe, is known under the name of sea buckthorn. It is commonly used for fish sauce in Russia. The plant is hardy in South Dakota. Prof. Hansen says that the berries of the tree contain a narcotic poison which is eliminated by boiling.

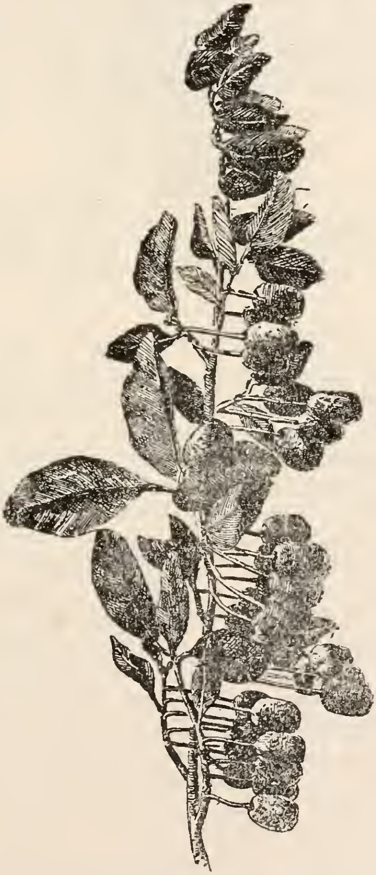

Fig. 363. Goumi (*Elaeagnus multiflora*). Cultivated for its edible fruit. (From American Agriculturist.)

THYMELAEACEAE. Mezereum Family.

Shrubs or small trees with acrid, tough, fibrous bark, simple opposite entire leaves; flowers in spikes or umbels, regular; calyx petal-like, tube, urn-shaped; petals present or absent; stamens twice as many as the lobes of the calyx, and borne on it; ovary free, 1-celled and 1-ovuled; fruit a berry-like drupe; embryo straight; endosperm scanty or none.

About 400 species of wide distribution, most largely represented in Australia and South Africa. The leatherwood or moosewood (*Dirca palustris*) with a tough fibrous bark, is used by the Indians for thongs. The Mezereum (*Daphne Mezereum*) with fragrant flowers and bright red berries, of Europe, naturalized from Europe in New England, and the handsome *D. Cneorum,* with rosepink flowers, are cultivated. The berries and leaves of the Mezereum cause blistering; it is an acrid poison. Bark paper (*D. cannabina*) native of the Himalayas to Japan, produces a tough bark which is made into paper. Lace-bark (*Lagetta lintearia*) of Jamaica, with bark that separates into layers, was formerly used for veils, bonnets, etc. The bark of *Wikstroemia viridiflora,* of the Polynesian Islands, is used for making fishing nets, ropes, etc. The bark of *Funifera utilis* of Brazil, causes vesication like that produced by the *Dirca palustris.* Several exotic plants of the family are poisonous like the *Pimelia trichostachya* of Australia. The fruit and leaves of *Gnidia carinata* are emetic.

Daphne, L. Laurel

Shrubs, with alternate leaves, and small purple, pink, or white flowers in fascicles, heads or racemes; perianth tubular, with 4 spreading lobes; stamens 8, attached to the calyx tube; filaments very short; disk none; ovary sessile; stigma large; calyx deciduous or persistent. About 40 species, native of Europe and Asia.

Daphne Mezereum, L. Spurge Laurel. Lady Laurel.

A small shrub with young twigs somewhat pubescent; leaves thin, oblong-lanceolate, or oblanceolate, petioled; flowers in sessile fascicles, very fragrant; perianth-tube pubescent, rose-purple; drupe red.

Distribution. Escaped from cultivation from Quebec to New York, native to Europe and Asia; frequently cultivated as an ornamental plant.

Poisonous properties. Some of the European species, like *Daphne Cneorum* contain acrid poisons. The plant produces blisters. The bark is used internally and in the form of an ointment. According to Loudon, in France the bark is applied to the skin for the purposes of a "perpetual blister." The bark, when fresh or when soaked in water, reddens the skin, when applied to it, and at length occasions vesicles followed by ulcers. Oesterlein remarked that all parts of the plant produced, on contact, irritation and inflammation. Schimpfky mentions this among the twenty-six important poisonous plants of Europe and states that the bark and berries are most poisonous, and that the pleasant odor of the flowers produces headache, for which reason, therefore, they should not be placed in a living room. Linnaeus seems to have recorded cases of poisoning from this plant. *Daphne* contains the glucoside *daphnin,* $C_{30}H_{34}O_{19}$, bitter and astringent, an acrid resin *mezerein, daphnetin* $(C_9H_6O_4)H_2O$, also with an astringent taste, *coccognin* $C_{20}H_{22}O_8$, and the glucoside *aesculin,* $C_{15}H_{16}O_8+H_2O$. Friedberger and Fröhner state that animals poisoned by the Daphne have stomatitis, slavering, colic and a feeble pulse. In Europe the fruit is sometimes used as a substitute for pepper, in some cases with fatal results. Blyth says: "There are a few cases of poisoning on record, and they have been mostly from the berries. Thus, Linne has recorded an instance in which a little girl died after eating twelve berries. The symptoms observed in the recorded cases have been burning in the mouth, gastro-enteritis, vomiting(giddiness, narcosis, and convulsions, ending in death. The lethal dose for a horse is about 30 grms. of powdered bark; for a dog, the oesophagus being tied, 12 gms.; but smaller doses of the fresh leaves may be deadly."

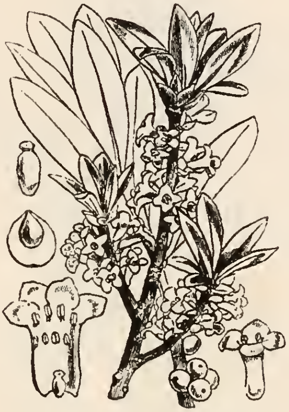

Fig. 364. Mezereum (*Daphne Mezereum*). An acrid poison. (After Fitch.)

Dirca, L.

A small shrub with tough, fibrous bark; short-petioled leaves; flowers yellowish, in peduncled fascicles of 2-4 scaly buds at the nodes of twigs of the preceding season; stamens 8, borne on the calyx, the alternate ones longer; filaments very slender; perianth bellshaped, or funnelform; disk obsolete; ovary nearly sessile; drupe red, oval, oblong. 2 species known, 1 in Eastern North America, and 1 in California.

Dirca palustris, L. Leather-wood.

A shrub with yellowish green twigs; leaves obtuse; bud-scales 3 or 4, oval, with brown hairs, deciduous; style longer than the stamens.

Distribution. In woods and thickets, Eastern Canada to Minnesota, Central Iowa to Missouri and Florida.

Poisonous properties. The bark is acrid, like that of the Daphne; all parts of the plant having a nauseous, acrid taste. The principle, however, is unknown. The fresh bark applied to the skin causes redness and vesication, the sores thus produced being quite difficult to heal.

ONAGRACEAE. Evening Primrose Family.

Herbs or rarely shrubs, with alternate or opposite leaves, generally without stipules, or stipules glandular; calyx adnate to the 2-4-celled ovary; petals 2-4; stamens as many as the petals or twice as many; ovules numerous. About 300 species. A few of the plants are medicinal. The great willow herb (*Epilobium angustifolium*) is occasionally used in medicine. The hairs of the seeds of some species are used in the Arctics as lamp wicks. Many species of the family are used for ornamental purposes, especially some of the western species of the genus, *Oenothera,* the *Clarkia elegans* of the gardens and the greenhouse *Fuchsia.* The genus *Oenothera* with many species, some southwestern and some western, contains very pretty plants.

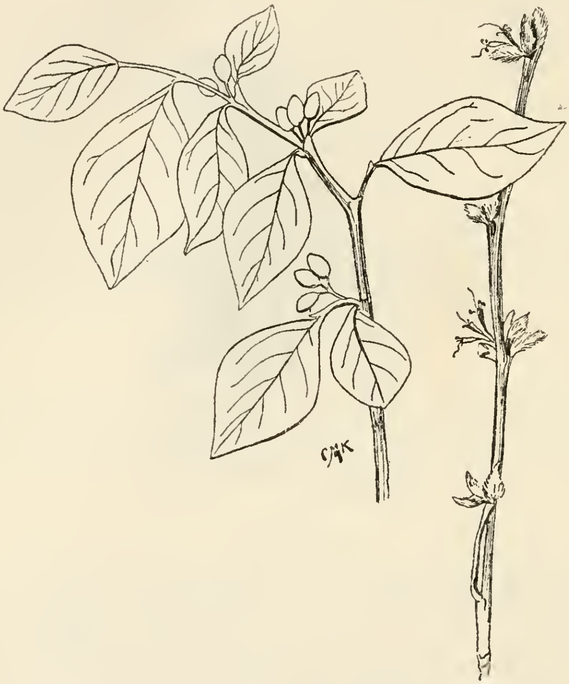

Fig. 365. Leather-wood (*Dirca palustris*). This plant is well known in northern woods, especially on the banks of streams; occasionally found on high land. The bark is very tough and regarded as poisonous. (Charlotte M. King.)

Gaura, L. Gaura.

Annual, biennial, or perennial herbs with alternate sessile leaves; flowers white, pink or red in spikes or racemes; calyx tube narrow, prolonged beyond the ovary, the limb usually 4-lobed, reflexed; petals clawed, unequal; stamens usually 8, with a small scale before the filament, frequently declined; ovary 4-celled; styles declined; fruit hard and nut-like, 3 to 4-ribbed and angled. About 18 species.

Gaura biennis, L. Gaura.

An erect, soft, hairy or downy annual or biennial; leaves lanceolate or oblong-lanceolate, denticulate; flowers in slender spikes, white, turning pink; fruit oval or oblong acute at each end, 4-ribbed.

Distribution. From Ontario to Georgia, Arkansas and Nebraska and Minnesota.

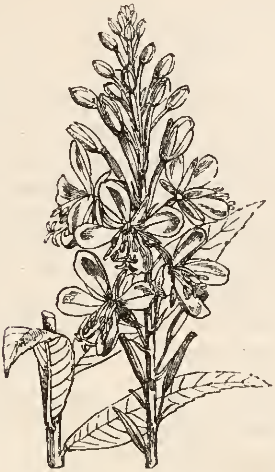

Fig. 366. Willow-herb (*Epilobium augustifolium*). Occasionally used in medicine. (After Fitch.)

Gaura parviflora, Dougl.

A hairy, branching, soft pubescent annual from 2-5 feet high; leaves lanceolate or ovate lanceolate, acute or acuminate, sessile, repand, denticulate, covered with long soft hairs; the pinkish flowers about ½ inch long, borne in long flexuose spikes 2-3 feet long; fruit contracted at the base, obtusely 4-angled, glabrous.

Distribution. Common in dry soil from South Dakota to Missouri, Louisiana, the Rocky Mountain region and New Mexico and Mexico. A common weed along irrigation ditches.

Gaura coccinea, Pursh. Scarlet Gaura.

An erect or ascending, much branched, smooth or canescent herb; leaves lanceolate, linear-oblong, repand or entire; flowers red, turning scarlet; fruit canescent, terete below, and narrowed above.

Distribution. From Western Minnesota, Iowa, Nebraska, and Texas to Utah, Arizona, and Mexico.

Poisonous properties. The Gauras, or at least one species, the *Gaura coccinea,* have been suspected of being poisonous to live stock in the West. This is an excellent honey plant.

UMBELLALES

Herbs, shrubs or trees; flowers nearly always with petals; divisions of the calyx and petals usually 5; stamens 4 or 5; ovary compound inferior, adnate to the calyx; epigynous ovule 1 in each cavity.

FAMILIES OF UMBELLALES

Fruit a drupe or berry.
Flowers umbellate; stamens 5.................................Araliaceae
Flowers not umbellate; stamens 4.............................Cornaceae
Fruit dry splitting into 2 mericarps.........................Umbelliferae

ARALIACEAE. Gingseng Family.

Herbs, shrubs or rarely trees; leaves alternate or whorled; flowers in umbels, heads or panicles; calyx tube adherent to the ovary; usually 5 petals inserted on the calyx; stamens as many as the petals, inserted on the disk; ovary 1 or more celled, 1 ovule in each cell; fruit a several-celled drupe.

About 50 genera and 450 species, of wide distribution. Genera common to eastern North America, China and Japan. Some of the species are occasionally cultivated for ornamental purposes. One of the best known of these is the Hercules Club (*Fatsia horrida*), native from Florida west to Missouri and Texas, and the common European ivy (*Hedera Helix*) well known in cultivation.

Few of the *Araliaceae* have injurious properties, however, the prickly spines of *Fatsia horrida* of the Pacific Coast, are quite irritating.

Several species of the genus Aralia and Panax are used in medicine. The

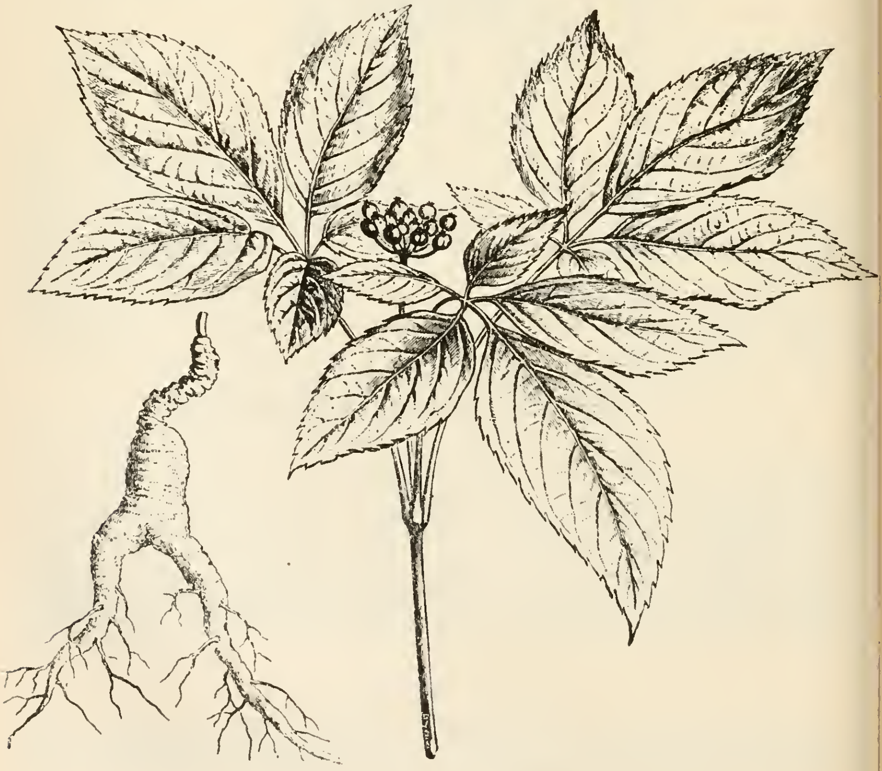

Fig. 367. Ginseng. (After Faguet.)

most important of these is the Ginseng, (*Panax quinquefolium*), which is native from eastern Canada to Alabama and in woods from Kentucky to Iowa, Missouri, Nebraska and Minnesota. This species is now widely cultivated, large quantities of Ginseng being exported to China, where the roots are in great demand. The Chinese Gingseng is *P. ginseng*. Several other species are used in medicine, among them the Spikenard (*Aralia racemosa*), and Wild Sarsaparilla (*Aralia nudicaulis*). These plants are not officinal, but they are quite commonly used. They have aromatic and stimulating properties. *Barringtonin*, $C_{18}H_{25}O_7(OH)_3$, is found in Barringtonia, a Japanese Aralia, Panax, and other genera. *Araliin* occurs in the roots of *Fatsia horrida*. The terpene, *aralien*, $C_{15}H_{24}$, occurs in *Aralia nudicaulis*. Some members of this order are occasionally weedy, especially the *Sarsaparilla*. Rice paper is made from *Tetrapanax papyrifera*, native to Formosa. It is a small tree about 10 feet high. The tree is cut into to obtain the pith, which is divided into thin slices and the paper cut with a sharp knife.

UMBELLIFERAE. Carrot Family.

Herbs with alternate compound or sometimes simple leaves, petioles often dilated at the base, rarely with stipules; flowers 1, small, in compound or simple umbels or heads, frequently polygamous; calyx tube adnate to the ovary, limb obsolete or 5-toothed; petals 5, inserted on the margin of calyx; stamens 5, inserted on the disk; pistils with 2 styles; fruit dry, composed of 2 carpels; generally spreading from each other at maturity.

About 1600 species of wide distribution in tropical and temperate regions. A number of the plants of the family are of economic importance, among them the carrot (*Daucus Carota*), native to Europe, cultivated before the Christian Era. The thickened roots of the carrot are important as food for man and

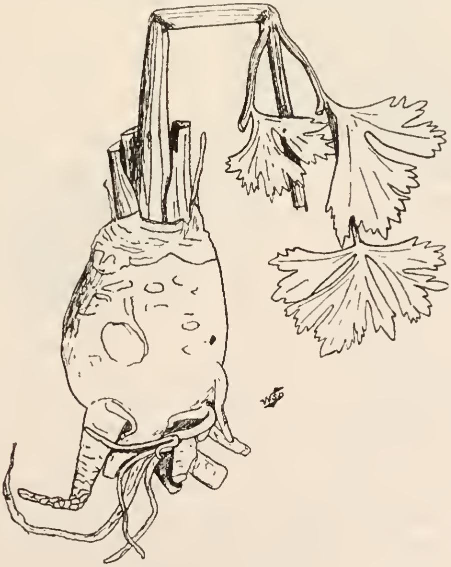

Fig. 368. Turnip rooted Celery or Celeriac (*Apium graveolens*). (W. S. Dudgeon.)

domestic animals. Parsley (*Carum Petroselinum,=Petroselinum hortense*), native to the Mediterranean regions of Europe and Asia Minor, is used for garnishing. Celery (*Apium graveolens*) is indigenous to Great Britain and other European countries, and is found growing in low lands. There are two types, the turnip rooted, cooked and eaten as a salad, and the blanched leaf stalks. Celery was known to the ancient Greeks and Romans. It is said that in a wild state the plant is somewhat poisonous. Some people are known to be sensitive to the cultivated plant. Dill (*Anethum graveolens*), containing dill oil and caraway (*Carum Carvi*), were known to the ancients. The essential oil of caraway is obtained from the seed, which is used in Europe to flavor bread and meats and contains *carvol* $C_{10}H_{14}O$. Dill (*Peucedanum graveolens*) is commonly used in flavoring pickles and salads. Cummin seeds from *Cuminum sativum* resemble those of caraway in odor and taste.

Many members of the order have medicinal properties. Among the more important of these are the Indian pennywort (*Centella asiatica*), and poison hemlock (*Conium maculatum*), which contains the alkaloid *coniin,* which is deadly poisonous. The caraway "seeds," fennel "seeds" (*Foeniculum vulgare*), the latter indigenous to the Caspian Sea regions, and yielding *anethol,* also contain *fenchone, trigonellin* and *cholin.*

The anise seeds (*Pimpinella Anisum*), containing the oil of anise, are used in confectionery. Asafoetida (*Ferula Narthex*) native to Thibet and western Asia, obtained from the milky juice of this plant, is used in medicine, and by the Persians as a condiment. The button snake root (*Eryngium yuccaefolium*), the cow parsnip (*Heracleum lanatum*), and the water hemlock (*Cicuta maculata*), are common plants in the northern states. The leaves and roots of the fennel (*Foeniculum vulgare*), used in southern Europe as table vegetables, and in Germany to flavor bread and cakes, contain *phellandrene* $C_{10}H_{16}$ and *chavicol*; lovage (*Levisticum officinale*) is found in salt marshes along the Atlantic coast from Labrador to Connecticut and in Europe. The *Arracacia xanthorrhiza* of Peru is much used in the Andes region. The same species, known in Venezuela as *Arracacha* and introduced into Porto Rico, is said by Fairchild to be one of the most important of food plants to the peon. The roots are large and fusiform. The roots of sea holly (*Eryngium maritimum*) when candied, boiled or roasted resemble chestnuts in taste. Gum Galbanum is derived from *Ferula galbaniflua,* and was used by the ancients for incense and perfumery. It contains *cadinene* and *d-pinene.* This is referred to in Exodus 25:10. Coriander (*Coriandrum sativum*) contains *coriandrol* $C_{10}H_{18}O$. Musk root or Sumbul (*Ferula Sumbul*) contains umbelliferone $C_9H_6O_3$ and *angelic acid* $C_5H_8O_2$ used as an antispasmodic. The plant occurs in Asia. Sweet Cicely (*Osmorhiza longistylis*) yields an oil similar to anise and contains *anethol.* In the *Umbelliferae* the substance *peucedone* $C_{15}H_{14}O_4$, occurs in the roots of *Imperatoria Ostruthium,* and *Peucedanum officinale; athamantin* $C_{24}H_{30}O_7$, is found in *Peucedanum Oreoselinum; laserpitin,* $C_{15}H_{24}O_4$, is from roots of *Laserpitium latifolium; pimpinellin* is obtained from the roots of *Pimpinella Saxifraga. Oenanthe crocata* contains *oenanthotoxin* somewhat similar to *cicutoxin; thymol* is found in the fruit of a great many of the *Umbelliferae; cumin oil* is secreted from the fruits of *Cuminum Cyminum* and other plants of this order, and contains *cymene;* anise seed or anise fruit contains anise oil which resembles that found in star anise; the *Oenanthe Phellandrium*

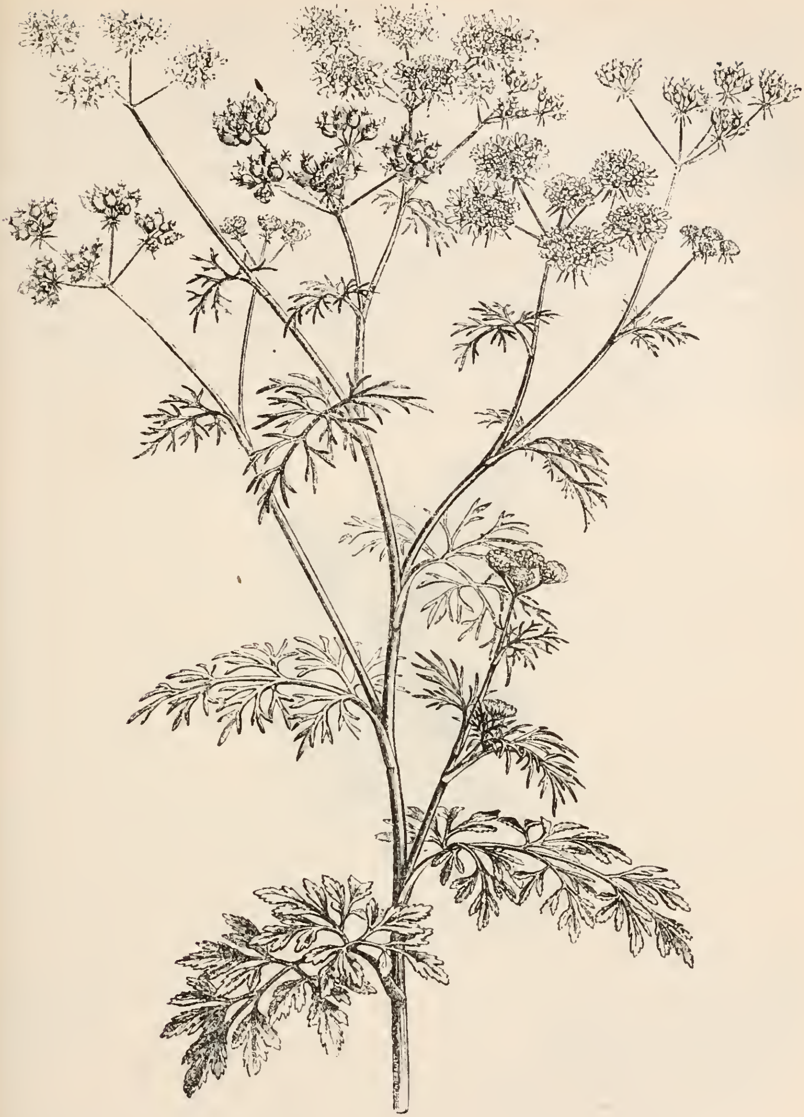

Fig. 369. Coriander (*Coriandrum sativum*). Flowering stem. (After Faguet)

contains *phellandrene;* a native lovage, *Ligusticum canadense,* is used to flavor tobacco.

This family contains a large number of plants with active principles, some of which are entirely harmless, but others must be considered among the deadly poisons. The water drop-wort (*Oenanthe crocata*), with its parsnip-like roots, and the *O. Phellandrium,* poisonous European plants, are *Umbelliferae.* Friedberger and Fröhner state that the former causes stomatitis and paralysis, Blyth states that the chemistry of the plant has not yet been worked out, but that all parts are poisonous, the root especially deadly. Lehmann states, however, that the first species is not as poisonous as was formerly supposed; sheep and hogs eat it, although it is poisonous to horses. In the latter it is said to produce paralysis of the hind legs. *Berula erecta* of Europe and North America is poisonous, especially the root. It is a smooth aquatic perennial, with compound simple pinnate leaves; leaflets linear oblong, serrate to cut-toothed; flowers white, and fruit globose.

In Australia according to Maiden the *Apium leptophyllum* when grown in damp soils is poisonous. The wild parsnip of that country is one of the most poisonous plants of Australia, no antidote to it being known. The *Chaerophyllum temulum* of Europe causes colic and stupor. The parsley is not ordinarily considered poisonous but is said to be injurious to birds. The gum resin *ammoniac* found on the stem of *Dorema Ammoniacum* is acrid. The resin results from the sting of an insect. The genus *Ferula* from which Asafoetida is derived causes haematuria and bleeding at the nose.

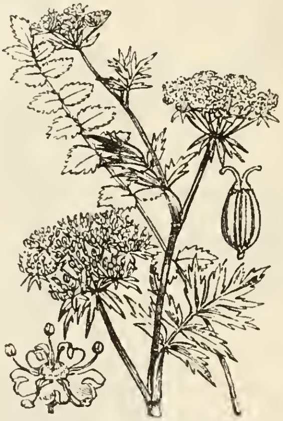

Fig. 370. Creeping Water-parsnip (*Berula erecta*). Very poisonous. (After Fitch.)

Genera of *Umbelliferae*

Flowers yellow..7 Pastinaca.
Flowers white or greenish.
  Fruit bristly, winged..9 Daucus.
  Fruit, not bristly, winged.
    Fruit winged, dorsally flattened.
      Flowers greenish..5 Angelica.
      Flowers white.
        Leaves pinnate or ternate, clustered, tuberous roots..6 Oxypolis.
        Leaves ternately-compound, root not tuberous.....8 Heracleum.
    Fruit wingless flattened dorsally or laterally................4 Aethusa.
    Fruit ovoid or oval.
      Flowers white.
        Biennial plant..1 Conium
        Perennial, roots usually fascicled.

Oil tubes solitary..................................2 Cicuta
Oil tubes 1-3.......................................3 Sium

Conium L. Hemlock

Smooth biennial herbs with spotted stems and pinnately compound leaves; flowers small, white, in compound umbels; calyx teeth obsolete; petals small, obcordate or entire; fruit glabrous, somewhat flattened laterally; carpels wavy-ribbed; oil tubes none, two species, one in Europe and Asia, the other African, deadly poisonous. Plant well known to the ancients.

Conium maculatum, L.

An erect, branching, smooth herb, with spotted stem and pinnately decompound leaves; flowers small, white, in compound umbels; calyx teeth obsolete, petals white; fruit smooth, ovate, flattened, with prominent wavy ribs; oil tubes absent.

Distribution. In waste places, Canada to Indiana, California, Utah and Mexico. Native to Europe.

Poisonous properties. The plant is very poisonous. It was used by the ancients to poison criminals condemned to death, and it is said that Socrates was poisoned by it. The plant is avoided by stock because of its strong odor, but the dried plants are not so poisonous. The alkaloid *coniin* $C_8H_{17}N$ is derived from it. *Coniin* is volatile in vapor of alcohol or water, and somewhat volatile at ordinary temperatures. It has an alkaline reaction and burning taste and causes dilation of the pupil. Two other principal alkaloids occur, namely: *conicein* $C_8H_{15}N$ said to be 18 times more poisonous than *coniin; conydrin* $C_8H_{17}NO$, *pseudoconydrin* $C_8H_{17}NO$ and *methylaconiin* $C_9H_{19}N$ occur in small amounts. The percent of *coniin* in fresh leaves is 0.095; the ripe seed contains 0.7 percent.

Mr. Chesnut says: Recent cases of poisoning have arisen accidentally from eating the seed for that of anise, the leaves for parsley, or the roots for parsnips; also from blowing whistles made from the hollow stems. It has recently been shown that some of the anise seed in both foreign and domestic markets is contaminated with hemlock seeds, but it is not known whether serious consequences have resulted therefrom.

Symptoms. The symptoms in man are due to a general and gradual weakening of muscular power. The power of sight is often lost, but the mind usually remains clear until death ensues, as it soon does from the gradual paralysis of the lungs. The poisoning differs from that of the Water Hemlock (*Cicuta maculata*) in the absence of convulsions. Many domestic animals have been killed by eating the plant, the prominent symptoms described for cows being the loss of appetite, salivation, bloating, much bodily pain, loss of muscular power and rapid, feeble pulse.

This plant, though called hemlock, should not be confused with the hemlock tree, which belongs to the family Coniferae. It paralyses the ends of the motor nerves, then trunks and lastly the motor center itself. Respiration is quickened and pupils contracted. The fatal dose according to Blyth is 2.3 grains.

2. *Cicuta* L. Water-Hemlock.

Tall, smooth, erect perennial herbs with pinnate or pinnately compound leaves and serrate leaflets; umbels terminal; flowers white; calyx teeth acute;

fruit ovate or oblong with solitary conspicuous oil tubes; corky ribs, the lateral ones strong; marsh herbs. Eight species, of north temperate regions. The European *C. virosa* is deadly poisonous. Hundreds of people have been poisoned in Europe. It acts much like our native cowbane, the symptoms being violent gastro-enteritis, dizziness, trembling, suggestive of hydrophobia, prostration, paralysis and convulsions.

Cicuta maculata L. Cowbane

A smooth marsh perennial from 2-5 feet tall, and with fasicled fusiform roots; leaves pinnately compound 2 or 3 times pinnate, long petioled; the coarsely serrate leaflets lanceolate to oblong lanceolate; stalks of the umbellets numerous and unequal; flowers white, fruit broadly ovate to oval, small, about 1½ inches long.

Distribution. Grows in marshes and low grounds in the Dakotas, Nebraska, the Rocky Mountain region of Colorado, Wyoming and Montana to the Uintahs, east of New Brunswick and Florida.

Poisonous properties. The European *C. virosa* contains *coniin* $C_8H_{17}N$ found also in *Conium maculatum,* and the bitter principle *cicutoxin,* an amorphous, resinous substance with a disagreeable taste. The poison resides in the root, stem, and leaves, but more particularly in the root. It seems to occur in an oily aromatic fluid.

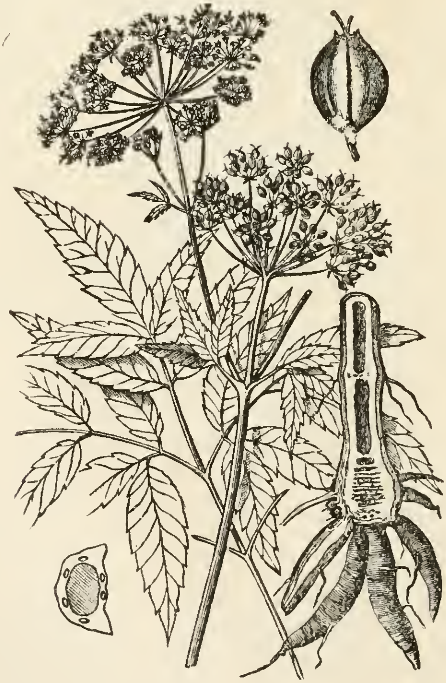

Fig. 371. Water Hemlock (*Cicuta maculata*), showing section of spindle-shaped roots and lower stem, the leaves, flowers, and fruit, one-half natural size; also fruit and cross section of seed, enlarged five times. A very poisonous plant. (U. S. Dept. Agr.)

The resinous cicutoxin, according to Boehm, is an uncrystallizable bitter body. The fatal dose, according to Chesnut, is 50 milligrams for each kilogram of body weight when administered through the mouth and 7 milligrams when injected hypodermically.

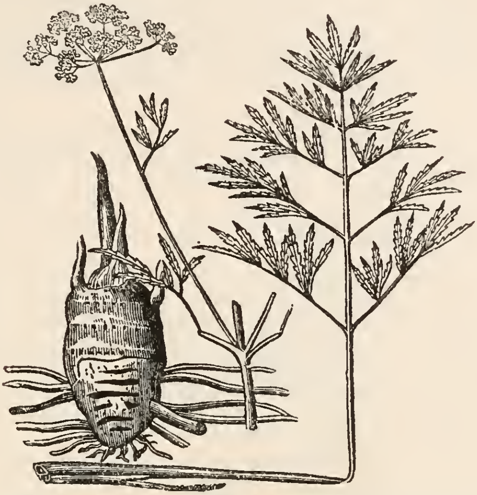

Fig. 372. European Water Hemlock (*Cicuta virosa*). A poisonous plant containing *cicutoxin*. (From Vesque's Traité de Botanique).

Mr. Chesnut says:

> Its true chemical nature is not definitely known, but it is probable that it contains the alkaloid *coniin.* and the bitter principle *cicutoxin,* the latter of which is characteristic of the European water hemlock (*Cicuta virosa*). Both are powerful poisons, but the latter is the more violent and produces most of the symptoms characteristic of the plant. The American water-hemlock is one of the most poisonous plants native to the United States. Its victims include both men and animals. The underground parts are the most poisonous, and are especially dangerous, because they are often washed or frozen out of the soil and thus exposed to view.

There are quite a number of cases of human poisoning on record in Wisconsin, Iowa, and Minnesota. Stock is also poisoned. People who are poisoned generally mistake the roots for parsnips. In Iowa it is often called wild parsnip. The roots of this plant are fascicled and never conical as in the true parsnip. During one season five children were poisoned in the state of Iowa, three dying, from eating the roots. Several cases of stock poisoning have occurred in Iowa and are referred to by the writer. The following interesting experience is related by Mr. J. A. Minteer, who says:

> I have just had a strange experience with my cattle, having lost a four year old cow and a yearling calf. I think that they were poisoned on some kind of weed root found in the slough. I locate it on a spot where a hay stack stood about two years ago. It had been removed except the spoiled hay in the bottom. Last fall being dry, I pitched it up, dried and burned the old hay, sowed rye and timothy seed, ran the disc harrow over it several times and noticed that we turned out lots of roots like small sweet potatoes, except that they were all connected at the top. I thought they were the root of a weed that grows a stalk similar to a seeded parsnip, have a straggly top similar to an elder berry when in bloom. The stalk when mature is hollow. Now I am not certain that I am right about the top as it had been mowed before I discovered the tubers. I never thought of them doing any harm, just thought we had torn them out so they would die and do me no harm, but as the cattle, 17 in number were

> brought up Sunday evening they appeared to be all right until they came into the barn yard, when a cow fell down and seemed to have a spasm. It only lasted a few minutes when she got up walked about 100 feet and fell again, got up and walked about thirty rods, fell again and died in about thirty minutes. The yearling was all right until turned into the lot. In about 20 minutes she was taken in the same way except a little more severely, rose 2 or 3 times and died in about 15 minutes. I was satisfied that they were poisoned, but the cause worried me for a while then I remembered the tubers I saw in the slough, I went next morning before turning the cattle out and found that the cow and yearling had eaten some of the roots. I gathered up nearly one-half bushel of the tubers, turned out the cattle and have had no trouble since. On opening the cows, I found considerable of the tubers in the stomach, and the inside of the stomach was very black.

The plant above ground likewise affects horses and evidently the poison may reside in the leaves for considerable length of time even after they are dried. The following experience of a correspondent in Ruthven, Iowa, calls attention to the danger of using hay that contains cowbane:

> I mail herewith a small paper box which contains some weed, of which I sent you a specimen last summer. This species of hemlock as you call it, I picked out of a manger of a stallion, which took suddenly sick this morning. Sickness lasted but a short spell. Do not know whether this had anything to do with this sickness but am terribly prejudiced against it. Another instance a few days ago of a colt taking violently sick all at once, apparently no cause, there being considerable of this weed in the hay, and I had two cows lose their calves a short time ago; the cows had access to this kind of hay. This quite frequently occurs hereabouts. On a neighboring farm where this weed abounds, they lost nearly all their calves two years ago. Apparently no cause, but of course there is a cause somewhere. I am satisfied some stock will eat the leaves of this weed.

Dr. Erwin F. Smith, in referring to the poisonous nature of this weed, speaks of a case as follows:

> During the warm days which melted the snow and brought back the birds and gave indication of spring time, some children of a neighborhood on the outskirts of the city gave vent to their feelings by digging and eating some artichokes which grew upon some low ground borderng a brook. Two of these boys were taken violently ill ,and one of them eight years old, died, within an hour after he had eaten the root.

Dr. Smith states that upon an examination of the stomach and the root from which he ate, it was proven beyond a doubt that *Cicuta maculata* was the cause of death.

Professor A. A. Crozier calls attention to the poisonous nature of cowbane in this state and refers to a case occurring in northern Iowa as follows:

> Hon. Eugene Secor, of Forest City, this state, a member of the Board of Trustees of the Iowa Agricultural College, brought me today a fleshy root of a plant of the Water-hemlock, (*Cicuta maculata, L.*). The circumstances which brought it to his notice were as follows: A neighbor of his by the name of Mr. Oleson, a farmer of about fifty years of age, while dragging some potato ground upon bottom land about two weeks ago discovered one of the fleshy roots of this plant, and supposing it to be an artichoke, ate it and gave a portion of it to his two sons. He soon began to feel queer or "funny" as he expressed it, and went to the house where he was taken with a spasm, followed by two or three others, when he became unconscious and within half an hour, before a physician could be summoned from the village, two miles distant, he was dead. The children had probably eaten less of the root and being given an emetic, recovered. The plant is very common in the state and the roots are so pleasant to the taste as to make it particularly dangerous. I may add that I ate a piece of the root the size of a filbert with little or no unpleasant effect."

One season the writer had a record of five cases of poisoning in this state. From a press bulletin issued by the writer the following facts were given to the public:

> Ira, aged ten, and Ross, aged eight years, children of T. Y. Johnson, died last night from eating the roots of a poisonous water plant that grows in front of their house on the Keg Creek flat east of the Ridgeway lumber yard. A third child, John, the seven year old son of Mrs. Amanda Kingery, also ate the root but it seems was not made so sick as the others.
>
> Shortly before six o'clock the children came into the house showing Mrs. Johnson what they had been eating. Not knowing what it was she had them spit it out and throw away

what they had in their hands. They went out to play again, but in about twenty minutes the two Johnson boys fell to the ground as if in a fit, soon passing into convulsions. The Kingery lad was able to walk to his home, but was soon taken with spasms. Dr. Hester was called and by a vomiting process in a few hours had the child out of danger.

Dr. Lyon was summoned to the Johnson home, getting there at 6:30. The little fellows were already in terrible convulsions and nothing could be done for them, one dying at 6:45 and the other at 7:15.

Dr. Millspaugh, in his American Medicinal Plants, Fascicle 4., No. 67, has recorded the following observations concerning the physiological action of the *Cicuta maculata*:

"Many cases of poisoning from the root of this species have been reported, all showing, by the symptoms, that Cicuta produces great hyperaemia of the brain and spinal cord. The following case reported by letter to Dr. Bigelow* by Dr. R. Hazeltine, (1818), gives all

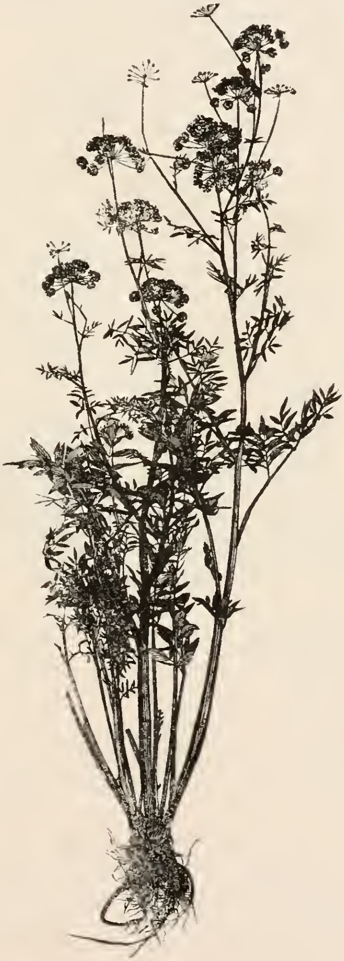

Fig. 373. Purple Stemmed Poison Hemlock (*Cicuta Douglasii*) of the Pacific Coast. It is very poisonous. (Chesnut, U. S. Dept. Agr.)

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*Bigelow, Amer. Med. Bot. Vol. III., p. 181.

the symptoms noted by other observers in various other cases. A boy had eaten of certain tuberous roots, gathered in a recently plowed field, supposing them to be artichokes but which were identified as the roots of *Cicuta maculata.* His first symptom was a pain in the bowels, urging him to an ineffectual attempt at stool after which he vomited about a teacupful of what appeared to be the recently masticated root, and immediately fell back into convulsions which lasted off and on continuously till his death. The doctor found him in a profuse sweat and convulsive agitations, consisting of tremors, violent contractions and distortions, with alternate and imperfect relaxions of the whole muscular system, astonishing mobility of the eyeballs and eyelids, with widely dilated pupils, stridor dentium, trismus, frothing at the mouth and nose, mixed with blood and occasionally violent and genuine epilepsy.

The convulsive agitations were so powerful and incessant, that the doctor could not examine the pulse with sufficient constancy to ascertain its character.

At the post-mortem no inflammation was observed, the stomach was fully distended with flatus, and contained "about three gills of muciform and greenish fluid, such as had flowed from the mouth; the mass assumed a dark green color on standing."

Chesnut in his paper on Some Poisonous Plants of Northern Stock Ranges says that Dr. Wilcox and himself observed 105 cases of water hemlock poisoning among sheep of which 50 were fatal, and 36 among cattle of which 30 were fatal. The loss was $4,000, only a fraction of what occurs in Oregon. The *C. vagans* and *C. Douglasii* are poisonous, the latter along the coast.

Mention may be made in this connection of a series of most valuable papers on "The Medicinal Plants of North America" by Dr. T. Holm in Merck's Reports.* In one paper he discusses the anatomy as well as the poisons found in this very poisonous plant. The effect of the poison is similar to that of *Cicuta virosa* and is due to a resinous substance *cicutoxin* and to the volatile alkaloid *cicutin,* which has been obtained from the fruits.

Cicuta vagans Greene. Oregon Water-Hemlock

A smooth perennial with glaucus stem and vertical rootstock divided into horizontal chambers; plant 2-3 feet high, with compound leaves; flowers white.

Distribution. From Idaho to British Columbia and west to northern California.

Poisonous properties. Same properties as the preceding. Professor Hedrick estimates that 100 head of cattle are killed by it every year in Oregon. A piece about the size of a marble of the winter rootstock is believed to be fatal to man. Professor Hedrick says:

> It is hard to estimate the number of cattle killed yearly in Oregon by eating Cicuta. One hundred would be a low estimate in my judgment. Animals eat the underground portion of Cicuta in getting the tops which form about the first green herbage in early spring; as they browse the foliage, the roots, being only partly subterranean, and growing in a soft soil, are pulled up and eaten. A piece the size of a walnut ,it is found by experiment, is sufficient to kill a cow. It is probable that the poisonous constituent is found only in the underground stem and the roots.
>
> While the victims of the plant are chiefly cattle, yet they are not exclusively so. The poisonous parts are often mistaken for Parsnips, Artichokes, and Horse-radish, and thus human victims are not infrequent. A number of cases of poisoning from Cicuta are annually reported in the United States. A writer in a local paper a few months ago, reported the case of two cattlemen in Southern Oregon, who, after eating "Wild Parsnip," presumably Cicuta. died in a few hours. Falk reports, that in Europe in thirty-one cases of poisoning from Cicuta, 45 per cent died.

The observations made by Prof. French and reported by Prof. U. P. Hedrick formerly of the Oregon Experiment Station have shown experimentally that this species is poisonous. A bulb was cut in small pieces, mixed with a carrot and fed to a two year old grade heifer. The animal was fed at 8:00 a. m. and at 9:30 it was dead. A post-mortem examination showed that pieces of the root occurred in the rumen, and in the reticulum or second stomach. Only a very small portion of the root had been eaten by the animal. Two grams were found in the stomach. The lungs were highly congested.

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*Medicinal Plants of North America, 24; Cicuta maculata, Merck's Rep. XVIII: 35-38, f.1-12. Feb. 1909.

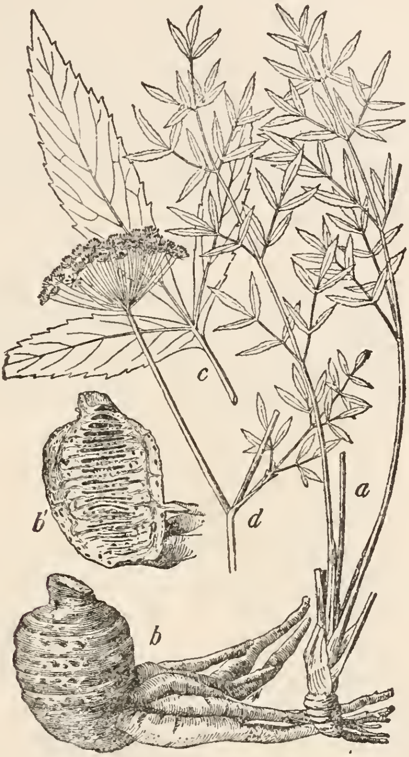

Fig. 374. Oregon water hemlock (*Cicuta vagans*): a, plant with leaves, one-sixth natural size; b and b′, rootstock and horizontal roots, showing section, half size; c, terminal leaflets, one-sixth natural size; d, flowering spray. (U. S. Dept. Agr.)

The following day a one year old calf was fed with the poisonous roots. The temperature of the animal was normal, 102½°. Two bulbs the size of an egg were cut and mixed with carrots; this material was eaten under protest. The roots were fed at 9:15 a. m. and at 9:40 the temperature was 103; at 10:00, 103½°; at 10:25, 104° and the animal was trembling about the flanks, the eyes watered freely; at 10:35 the animal was excited and the temperature was 104¼°; at 10:45 the animal fell over on its side in a spasm. The eyes were drawn and the muscles were rigid and contracted violently.

Before death an attempt was made to revive the animal by giving it spirits of turpentine; this caused the calf to recover its feet and walk about. A second dose of turpentine and milk were given and the animal remained standing until 11:30, then it fell down as before. A full dose of aconite was given, but no results noticed and then a hypodermic injection of nitro-glycerin was given. Death occurred at 11:45 and spasms were almost continuous.

The most interesting discovery made by Prof. Hedrick was in regard to the apparent harmlessness of the roots while growing during the summer.

Prof. Hedrick says concerning the roots fed to an animal early in May:

> The bulbs were of the same lot used in the first experiments, but had been growing for a month in a green house. It was expected that growth would remove some of the dangerous properties of the bulbs, but it was a surprise to find that an animal eating many times as much of them as had killed the cows in the previous experiment suffered no ill effects whatever. The conclusion is obvious; the bulbs are only dangerously poison when in the dormant state, or for a short time after growth begins in the spring. Cattle are likely, then, to be poisoned only from the first of January to the middle of May.

Cicuta Bolanderi Watson.

Leaves bipinnate, leaflets narrowly lanceolate, long acuminate, acutely serrate, lower leaflets petiolate and often deeply lobed; involucre of several linnear leaflets; fruit 2 lines long, nearly orbicular, strikingly ribbed, and broad oil tubes.

Distribution. In salt marshes along the Pacific coast in California.

Poisonous properties. Like those of the preceding species.

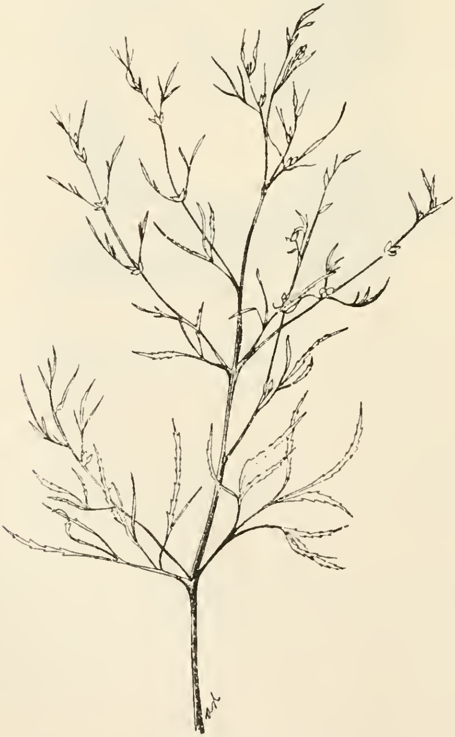

Fig. 375. Water Hemlock (*Cicuta bulbifera*).
A powerfully poisonous plant. (Ada Hayden.)

Cicuta bulbifera L. Bulbous Water-Hemlock

A slender perennial from 1-3 feet high; leaves 2-3 times pinnate; leaflets linear; sparingly toothed, 2 inches long; upper axils bear clustered bulblets; fruit small, ovate.

Distribution. In swamps Nova Scotia to Delaware, Indiana, Iowa, Nebraska and Manitoba.

Poisonous properties. Very poisonous, like the other species described above.

3. *Sium* (Tourn.) L. Water Parsnip

Smooth perennial herbs with stem leaves pinnate, basal leaves with pinnatifid leaflets; flowers white in large umbels; calyx teeth minute; short styles; fruit ovate to oblong with prominent ribs; 1-3 oil tubes. A small genus of 8 species in temperate regions. The *S. latifolium* is poisonous especially to cattle. It produces stupor, excitement and gastro-enteritis.

Sium cicutaefolium Schrank. Water Parsnip.

An erect stout marsh herb from 2-6 feet high; lower leaves with long petioles; leaflets 3-8 pairs; segments linear or lanceolate, sharply serrate; flowers in umbels, white; fruit ovate, prominently ribbed.

Distribution. From Nova Scotia across the continent to Florida and California.

Poisonous properties. The water parsnip is reported as poisonous from several different sources. Hyams reports it poisonous in North Carolina.

4. *Aethusa* L. Fool's Parsley.

Annual glabrous herbs. Leaves 2-3 ternately compound, dissected; umbels compound without involucre; involucels long and narrow; flowers white; calyx teeth obsolete; fruit globose, ovoid, glabrous, flattened dorsally. One species native to Europe and Asia.

Aethusa Cynapium L. Fool's Parsley

An erect leafy branched annual. Leaves 2-3 times pinnate; petiole dilated at the base; umbels long peduncled.

Distribution. In cultivated grounds and waste places from Nova Scotia, New England to Pennsylvania and New York.

Poisonous properties. Contains the alkaloid *cynapin,* and a coniin-like alkaloid. One physician in England regards the plant as non-poisonous, even recommending it as a pot herb or for salad uses. On the other hand numerous cases of poisoning have been recorded. The following may serve as an illustration which is recorded by Dr. Millspaugh from a statement made many years ago. He records the experiments made on animals. Seven ounces of the juicy leaves were given to a strong dog and the oesophagus tied; twenty minutes thereafter the dog became sick. He stretched out his limbs, and lay on his stomach and it was impossible to arouse the animal. The pupils were scarcely dilated, the pulsations of the heart were slow and strong. The extremities were agitated by convulsive movements; the animal threw himself from one side to the other, and died an hour after taking the poison. The post-mortem examination showed that the heart was contracted and the stomach was found to be full of the poison. In domestic animals it causes stupor, paralysis and convulsions. The common name indicates that it is sometimes mistaken for parsley with injurious results.

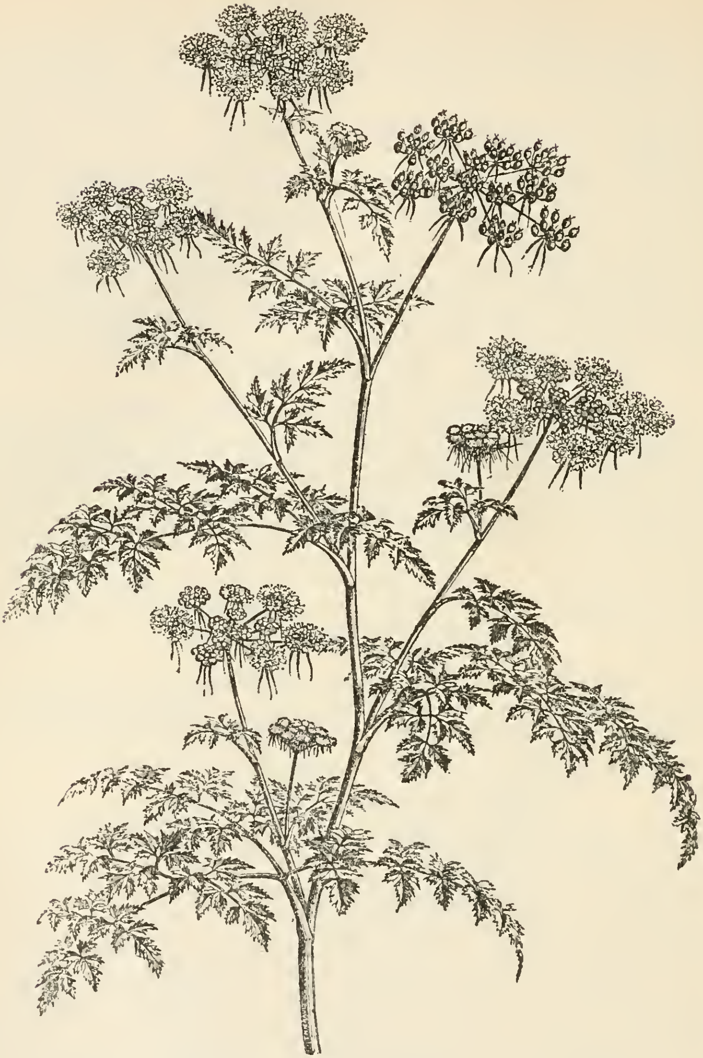

Fig. 376. Fool's Parsley (*Aethusa Cynapium*). Flowering branch. Supposed to be poisonous to animals. (After Faguet.)

5. *Angelica* L. Angelica

Stout perennial herbs with ternately or pinnately compound leaves in large ample umbels with white or greenish flowers; involucre none or of few small bracts; calyx teeth wanting; fruit strongly flattened with prominent lateral wings; oil tubes solitary or several; the 30 or more species found chiefly in the northern hemisphere and New Zealand.

Angelica atropurpurea L. Great Angelica

A stout smooth perennial from 3-5 feet high; large ample, ternately divided leaves, pinnate segments, ovate-lanceolate and broad dilated petioles; flowers in large umbels 9-25 rayed; fruit broadly oval, oil tubes 25-30.

Distribution. Common in swamps from Labrador, Wisconsin, Minnesota, Illinois to Delaware.

Poisonous principles. Supposed to be poisonous. Although no cases have been reported to the writer, it is known that the Indians of Canada used the fresh roots for suicidal purposes. On drying, however, the roots lose their poisonous properties. Dr. Millspaugh says that they are considered carminative, diuretic, emmenagogue and stimulant. The dried root was often used, especially in combination with other and better known diuretics, in anasarca and various diseases of the urinary organs; and alone in flatulent colic and suppressed menstruation. Dr. Schell claims that doses of 15 to 20 grains of the dried root will cause a disgust for all spirituous liquors. The stems were often made into a candied preserve in some sections of the country—a practice now nearly extinct.

6. *Oxypolis* Raf. Cobwane

Perennial, glabrous marsh herbs, with clustered tuberous roots; leaves reduced, pinnate or ternate; flowers white, in compound umbels; calyx teeth acute; fruit ovate, dorsally flattened, compressed; dorsal ribs slender, the lateral broadly winged; oil tubes solitary in the intervals, 2-6 on the commissure. Species 4, native to North America. Poisonous.

Oxypolis rigidior (L.) Coult and Rose. Cowbane.

A slender marsh perennial from 2-5 feet high. Roots tuberous, clustered; leaves simply pinnate, petioled; leaflets thick, ovate-lanceolate or oblong-entire or denticulate; involucre of 1-4 bracts or none; flowers white; oil tubes small.

Distribution. In swamps from New York to Florida, to Missouri and Minnesota.

Poisonous property. The roots and leaves are known to be poisonous. Said to poison cattle.

7. *Pastinaca* L. Parsnip

Tall, branching biennial herbs, pinnate leaves, thick conical roots, compound umbels with yellow flowers; involucres and involucels commonly absent; obsolete calyx teeth; fruit smooth, oval, flattened, the lateral ribs extending into broad wings; oil tubes solitary, 2-4 on the commissure. Six or seven species native to Asia and Europe.

Pastinaca sativa L. Wild Parsnip

Tall branched biennial or annual herb with thick conical roots, pinnately compound leaves smooth or somewhat pubescent; calyx teeth obsolete; petals yellow, fruit oval, glabrous, flattened dorsally, seeds flat.

Distribution. Common in the northern states and on the Pacific coast, where it has escaped from cultivation.

Poisonous properties. Frequently confused with cowbane and said to produce poisoning. The writer has not received a single specimen where Wild Parsnip was said to have produced the poisoning, that the plant did not prove to be cowbane. The wide spread belief of the poisonous nature of the cultivated parsnip running wild is entertained by a large number of people and also to some extent by the medical fraternity. A few years ago Professor Frederick B. Power and one of his pupils (Mr. J. T. Bennett) undertook some experiments to determine whether the cultivated parsnip running wild had any toxic properties. Mr. Bennett failed to detect the presence of any poisonous principle in the root of the true wild parsnip (*Pastinaca sativa*) and when the boiled roots were fed in considerable amounts to a cat, no symptoms of poisoning were manifest. We may add as a further testimony that Professor Power reports that his associate, Dr. Kremers, insisted upon eating one-half of one of the raw roots obtained from Mr. Rynning of West Salem, Wisconsin, which were supposed to cause cases of the poisoning. Dr. Kremers reported no ill effect whatever. One of the largest of the fresh raw roots weighing three and one-half ounces avoirdupois was chopped fine, mixed with some meat and fed to a small dog. The animal ate it greedily and without disturbance. There were no symptoms whatever of poisonous action. I have on different occasions eaten the wild parsnip (*Pastinaca sativa*), without any ill effect, so that the above results are corroborated. I will admit that I had some hesitancy at first and that Mr. Sexton, the foreman of the horticultural department at the Iowa State College did not expect to see me alive by evening. I must confess also that the roots were somewhat woody and not very palatable.

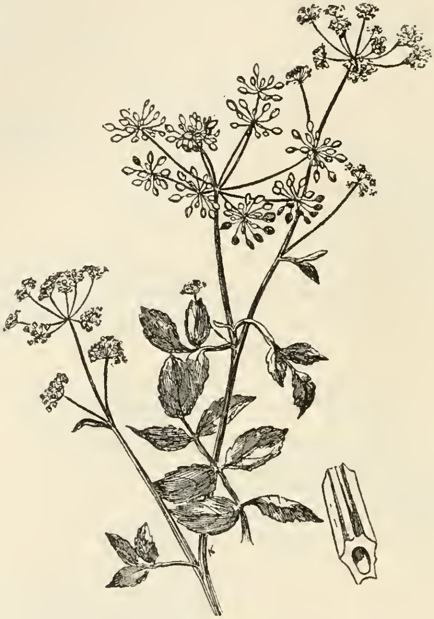

Fig. 377. Wild Parsnip (*Pastinaca sativa*). A plant with yellow flowers and is feral form of ordinary parsnip. Often mistaken for Cowbane. (Charlotte M. King.)

Dr. J. J. Brown, Sheboygan, Wisconsin, as quoted by Dr. Power, states that he had prepared and dug enough wild parsnips for a good dinner which he ate and can testify that he could discover but little difference cooked or raw, from cultivated parsnip and those which had run wild for about 50 years.

That the parsnip does at times produce dermatitis has been proven. The following verey interesting letter from Professor F. C. Stewart, botanist of the New York Agricultural Experiment Station, is of interest in this connection:

> I recollect that some fifteen years ago you were much interested in the reputed poisonous properties of the wild parsnip, and that you reached the conclusion that wild parsnip is not poisonous. I think you may be interested to know of an instance which has recently come to my attention. Henry VanDreser, a prominent lecturer on poultry in this state, last season had a very serious injury to his face and eyes. His face became badly swollen and his eyes were in a terrible condition. It was feared at the time that they would be ruined, but the sight was not lost although it was considerably impaired. The physician in charge diagnosed it as a case of poisoning, due probably to the flowers of wild parsnip. Very shortly before the trouble appeared Mr. VanDreser had been mowing a large patch of wild parsnip which was in bloom. It was a hot day, so that he perspired profusely. He gathered bunches of the wild parsnip plants in his arms and carried them. This brought the plants in contact with his face. Both Mr. VanDreser and the physician feel confident that the wild parsnip was the cause of the trouble. Another gentleman who heard of this case told me that some years ago he lost a little girl with poisoning of a somewhat similar character, and it was attributed to the parsnip blossoms, among which the little girl had been playing immediately before the attack.

The writer has also known of a few cases of dermatitis produced by this plant. Poisoning similar to the above may be produced by other members of this family notably the cowbane. A young high school lad in Boone lost his life in a way similar to that from *Pastinaca sativa*.

8. *Heracleum* L. Cow Parsnip

Tall stout perennials with large ternately compound leaves; flowers in large umbels; involucre deciduous and involucels of numerous linear bracts; calyx teeth obsolete or small; petals white, clawed, the outer flowers dilated; fruit broadly obovate, flattened, lateral ribs broadly winged, the intermediate narrow; oil tubes extending to about the middle. About 60 species, of cooler regions.

Heracleum lanatum Michx. Cow Parsnip

A stout, hairy, pubescent perennial from 4-8 feet high; leaflets broad and large, irregularly cut-toothed; flowers white, in broad umbels.

Distribution. From the Atlantic coast, Newfoundland, through the northern states and Allegheny Mountains to California. Common in the Rocky Mountains.

Poisonous properties. Said to be poisonous although the leaves of the fresh plant are eaten by the Indians. It contains the bitter principle *heraclin* $C_{32}H_{29}O_{10}$. The roots have a disagreeable flavor. Hyams states that it is poisonous and Halsted says that cow parsnip will produce blisters.

Daucus Tourn. Carrot

Bristly annual or biennial herbs with pinnately de-compound leaves; umbels compound, of white or reddish flowers; involucre of numerous entire or toothed bracts; calyx teeth obsolete; petals obovate with apex turned in; the outer flowers often dilated; fruit oblong, flattened with 5 primary ribs, secondary ribs 4 winged, each bearing a row of prickles. About 25 species of wide distribution.

9. *Daucus Carota* L. Wild Carrot

Biennial or annual bristly herbs and conical tap root; lower leaves 2-3 times pinnate, segments dentate lobed or pinnatifid, bracts of the involucre of linear divisions; flowers white or pinkish.

Distribution. Native to Europe. Common in fields and waste places in the north to the Pacific coast. It is the original of the cultivated carrot.

Injurious properties. The fruit often clings to wool, making it of inferior quality. The leaves of the plant cause vesication. This is especially true when the plant is wet with dew. In Australia, according to Maiden, the *Daucus brachiatus* is injurious to sheep, the hooks sometimes entering the skin.

CORNACEAE Link. Dogwood Family.

Shrubs or trees, with opposite or alternate leaves; calyx tube adnate to the ovary, lobes small; petals as many as the stamens, 4-5, inserted on the disk; stamens as many as the petals or more numerous; ovary inferior, 1-2 celled; style 1, ovules 1, in each cavity; fruit a 1-2 seeded drupe.

A small family of 16 genera and about 85 species, containing several plants cultivated for ornamental purposes, such as the red osier (*Cornus stolonifera*), native from Nova Scotia south to Virginia, Kentucky, northeastern Iowa, Nebraska, the Rocky Mountains, California and Alaska.

The *Aucuba japonica*, with handsome red berries, is cultivated in greenhouses; it contains the glucoside *aucubin* $C_{13}H_{11}OH+H_2O$.

Flowering dogwood (*Cornus florida*) is a small tree or large shrub, cultivated for its large corolla-like bracts. It is native in dry woods from southern New England to Ontario, Illinois, Missouri, and Texas. The western dogwood (*Cornus Nuttallii*) of the Pacific, is a beautiful tree from 20-75 feet high and 1-2 feet in diameter. It produces a close grained wood that is capable of receiving a high polish and is used for furniture, cabinet work, and water wheels. Tupelos (*Nyssa aquatica*) and (*N. sylvatica*) produce wood of some importance.

The dogwoods, especially the flowering dogwood and the round-leaved dogwood (*Cornus circinata*) are used in medicine; the bark contains the bitter principle *cornin.* Some species, like panicled dogwood (*C. paniculata*) are occasionally troublesome in newly cultivated fields.

Poisonous properties. At various times, members of this family have been suspected of being poisonous. Two species, *Cornus Amomum* Mill. and *C. paniculata* L'Her. (= *C. candidissima* Mill.) are thus listed in Part I of this Manual. Actual poisoning from species of Cornus has not, so far as is known to the present author, been observed. Greshoff, however, lists as poisonous *C. Amomum* Mill., *Alangium Lamarckii* Thwait., and *Garrya Fremontii* Torr.

METACHLAMYDEAE

Petals partly or wholly united, rarely separate or wanting; tubular or funnel-form. This includes the important plants classed as *Gamopetalae.*

Ericales

Flowers complete, regular with lobed or distinct calyx; corolla cleft; stamens free from corolla; ovary compound. This order includes such families as *Pirolaceae* and *Ericales.*

ERICACEAE. Heath Family.

Shrubs, trees or occasionally herbs, with simple leaves; flowers regular, or nearly so, generally perfect; calyx usually free from the ovary, 4-5 lobed, generally persistent; corolla of 4-5 petals or 4-5 lobed; anthers 2-celled, commonly appendaged or opening by pores; ovary 3-10 celled; style 1; pollen consisting usually of 4 united grains; embryo small.

A large family of wide distribution. About 1400 species. Several species of the family are frequently cultivated for ornamental purposes—notably the rhododendron and the wild laurels (*Rhododendron catawbiense, R. maximum*), which are hardy out of doors in the south and east. The azalea (*Rhododendron indicum*) is frequently cultivated in greenhouses, flowering in late winter and early spring; the garden azalea (*Rhododendron sinense*) is cultivated in gardens.

The California mountain laurel (*R. californicum*) is a very attractive ornamental shrub or small tree and one of the most handsome of the genus in North America.· Among the other cultivated members of this family, mention may be made of the mountain laurel (*Kalmia latifolia*). The South African species of the genus are frequently cultivated in conservatories. The Scotch heather (*Calluna vulgaris*) of Europe has been found on Nantucket Island. The May flower or trailing arbutus (*Epigaea repens*) is well known to people living in the Eastern and Northern States. The rich, spicy fragrance makes it one of the most attractive of our early flowering plants. Several species of the genus *Vaccinium* are cultivated for their fruits. Among them are cranberries; the larger berry being *V. macrocarpon*, which is the most common species in North America, and is cultivated extensively in Wisconsin, Michigan, New Jersey and Massachusetts. The smaller cranberry *V. Oxycoccus* is also sold under the name of Lingon berries and is common in Sweden and Norway and far northward in North America. The berries of this fruit are smaller and more acid than are those of *V. macrocarpon.*

The blue berries and huckleberries are obtained from several native species of the genus *Vaccinium* of the East. Dwarf blueberries of our northern dry woods are (*V. pennsylvanicum* and *V. canadense*). Another blueberry (*V. vacillans*) produces a sweet edible berry and occurs from Maine to Missouri. The mountain blueberry of the southern Alleghanies is *V. corymbosum*, var. *pallidum.* The tall blueberry (*V. corymbosum*) has a pleasant acid flavor, and attains a height of 5-10 feet. In the Rocky Mountain, Lake Superior and White Mountain regions, there are several species of blueberries as *V. caespitosum* with blue sweet berries and *V. membranaceum,* which produces large black berries, and grows from 1-5 feet high.

The huckleberry (*V. stamineum*) is not edible, nor is the fruit of the small tree known as farkle berry (*V. arboreum*). The huckleberry (*Gaylussacia baccata*) is edible. These come up spontaneously in burnt areas. The fruit is gathered from Maine to Minnesota. The shallon (*Gaultheria Shallon*) of the Pacific coast, is a shrub or small tree with stout erect branches, and produces edible fruit with a spicy aromatic flavor. There are several species of arbutus, one of which, Madrona (*Arbutus Menziesii*), forms a tree 1-6 feet in diameter and 20-100 feet high, the wood being used for cabinet work. The strawberry tree (*Arbutus Unedo*) is a native of Southern Europe to northern Africa. The fruit when ripe resembles the strawberry, but is not edible. Several members of the order are used in medicine. One species only, however, is generally recognized. The Pipsissewa (*Chimaphila umbellata*) used for cutaneous eruptions, contains *chimaphin* $C_{24}H_{21}O_4$. The bear-berry (*Arctostaphylos Uva-ursi*) is found throughout the mountain regions of North America—Pennsylvania, Illinois, Missouri to Nebraska, the Rocky Mountains and northward. It is an astringent tonic used in diseases of the liver, and contains *ericolin*; *arbutin, ursone* $C_{10}H_{16}O$. The wintergreen (*Gaultheria procumbens*) is a small creeping shrub with evergreen leaves and edible fruit, and is used for the production of the oil of wintergreen which serves as an aromatic stimulant and also in rheumatism. The fragrance is due to a volatile oil.

Drs. Price and L'Engle quite recently mention a case of poisoning from the oil of wintergreen. In this case a child swallowed the contents of a bottle containing oil of Gaultheria. The symptoms of poisoning were increased pulse, labored and irregular respiration, hearing impaired, some hallucinations of vision, twitching of heart and weak diarrhoea. The child died.

Many of the *Ericaceae* contain the glucoside *ericolin* $C_{34}H_{56}O_{21}$; this in turn contains *ericinol* $C_{10}H_{16}O$, a peculiarly fragrant oil; *ericolin* occurs in the leaves of *Ledum, Erica, Calluna, Rhododendron, Gaultheria* and *Epigaea*. *Rhododendron* $C_{16}H_{22}O_7$, is found in the leaves of *Rhododendron chrysanthum;* it is converted by hydrolysis into *rhododendrol*, $C_{10}H_{12}O_2$. *Oxycoccin* occurs in *Vaccinium Oxycoccus.*

Andromedotoxin or *acetotoxin,* found in the leaves of *Andromeda Polifolia* and *A. japonica,* and also in many other *Ericaceae,* as *Azalea, Rhododendron Japonicum, A. javanicum,* and *Kalmia* is one of the most toxic substances known.

Asebotin, $C_{24}H_{28}O_{12}$, derived from *andromedotoxin,* and *asebogenin,* $C_{18}H_{18}O_7$, are found in *Andromeda Japonica. Arbutin* $C_{12}H_{16}O_7$, occurring in the leaves of many of the *Ericaceae* was first detected in *Arctostaphylos Uva-ursi; quercetrin* is found in *Calluna,* as is also *calluna tannic acid.*

In Lehmann's work on the poisonous plants commonly found in Germany only one species of this family is listed as poisonous, namely the Labrador tea (*Ledum palustre*) of the Arctic region. This pretty shrub, growing in swamps, has alternate entire leaves with rusty wool underneath; revolute margins; white flowers in umbel like clusters; followed by a many seeded capsule. The *L. groenlandicum* related to it and also occurring in swamps, thickets and on mountain slopes but further southward has wider leaves and is a larger plant.

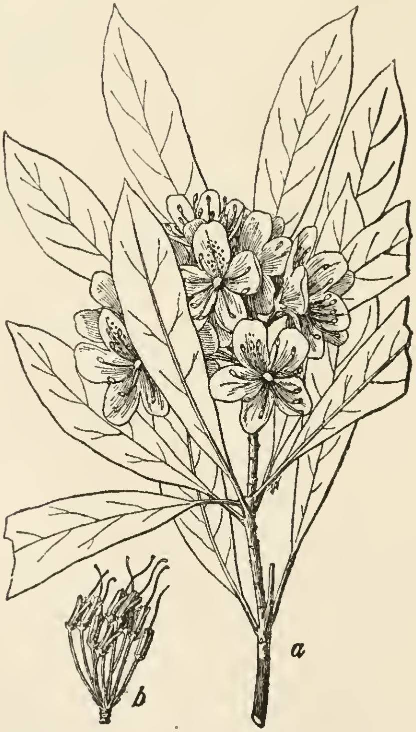

Fig. 378. Great laurel (*Rhododendron maximum*): a, flowering branch; b, fruiting capsules—both one-third natural size. Very poisonous. (U. S. Dept. Agr.)

The *L. glandulosum*, similar to the above but a taller plant, occurs in bogs of the Rockies. All are more or less poisonous; one species is known to contain *andromedotoxin*. Several species are used as a substitute for tea. The Russians use the first named species. It is also said to be used to protect clothes from moths.

Genera of *Ericaceae*

Fruit a septicidal capsule; anthers unappendaged.
Corolla somewhat irregular.
Corolla slightly 2-lipped, leaves deciduous.....(Rhododendron-Azalea)
Corolla campanulate; leaves evergreen.................1 Rhododendron
Corolla regular.
Stamens 10; capsule 5-celled.............................2 Kalmia
Fruit a loculicidal capsule; anthers often awned.
Corolla cylindrical; capsule depressed....................3 Leucothoe
Corolla globose or urn-shaped: capsule globular......................
Anthers awned ....4 Andromeda
Anthers awnless ....5 Lyonia

Rhododendron L. Rose Bay

Shrubs or trees, with deciduous or persistent leaves; flowers in corymbose or umbellate clusters from scaly cone-like buds; calyx 5-lobed, or 5-parted; corolla bell-shaped, 5-lobed, nearly regular or irregular; stamens 5-10, spreading, declined and slightly or not exserted; anthers opening by terminal pores; style slender, occasionally exserted and somewhat declined; fruit a woody capsule; seeds numerous. About 100 species, native of cooler regions. Several species cultivated for ornamental purposes. The genus includes Azalea.

Rhododendron californicum, Hook. California Rhododendron.

A shrub or small tree from 3-25 feet high, with stout erect branches; leaves evergreen, broadly oblong, 3-6 inches long; flowers large, in corymbose clusters; calyx 5-lobed; corolla bell-shaped, rose color; capsule 1-1¼ inches long.

Distribution. On the Pacific slope from San Francisco north to British Columbia.

Rhododendron maximum, L. Rose Bay or Great Laurel

A tall evergreen shrub or small tree; leaves 6-10 inches long, thick and leathery, oblong-lanceolate, dark green on both sides, with revolute margins; flowers in corymbose clusters, pedicels viscid pubescent; corolla bell-shaped, 1 inch broad, pale rose color or nearly white or spotted with yellowish orange dots; fruit an oblong capsule.

Distribution. In damp woods from Maine to Ohio and the Alleghenies to Georgia.

Rhododendron catawbiense Michx. Mountain Rose Bay

Shrub from 3-6 feet high, or rarely small tree 20 feet high; leaves oval or oblong, mucronate, dark green above, pale or glaucous beneath; petioles stout; pedicels rather stout; corolla broadly bell-shaped, lilac-purple; petals rusty-brown.

Distribution. On mountain slopes of Virginia, West Virginia, and Georgia.

Poisonous properties. According to Chesnut, *Rhododendron californicum* is said, in Oregon, to be poisonous to sheep. The substance *andromedotoxin*, $C_{31}H_{51}O_{10}$, a bitter principle, has been found in *Rhododendron maximum*. It is extremely poisonous, even more so than aconitin, and more emetic than emetin. *Rhododendron ponticum* contains the glucoside *arbutin*.

Rhododendron occidentale A. Gray. California Azalea

Shrub 2-6 feet high, shoots glabrous or minutely pubescent when young, not bristly; leaves obovate-oblong, sometimes approaching lanceolate, bright-green and shining above, minutely pubescent, glabrate, the margins minutely hispid-ciliate; scales of the flower-bud somewhat canescent; flowers appearing after the leaves; sepals distinct, oblong or oval, conspicuous; corolla minutely viscid-pubescent outside, white, with the upper lobe yellow inside; the narrow funnel-form tube equalling the deeply 5-cleft slightly irregular limb; the lobes ovate; stamens and style much exserted, moderately curved; capsule oblong.

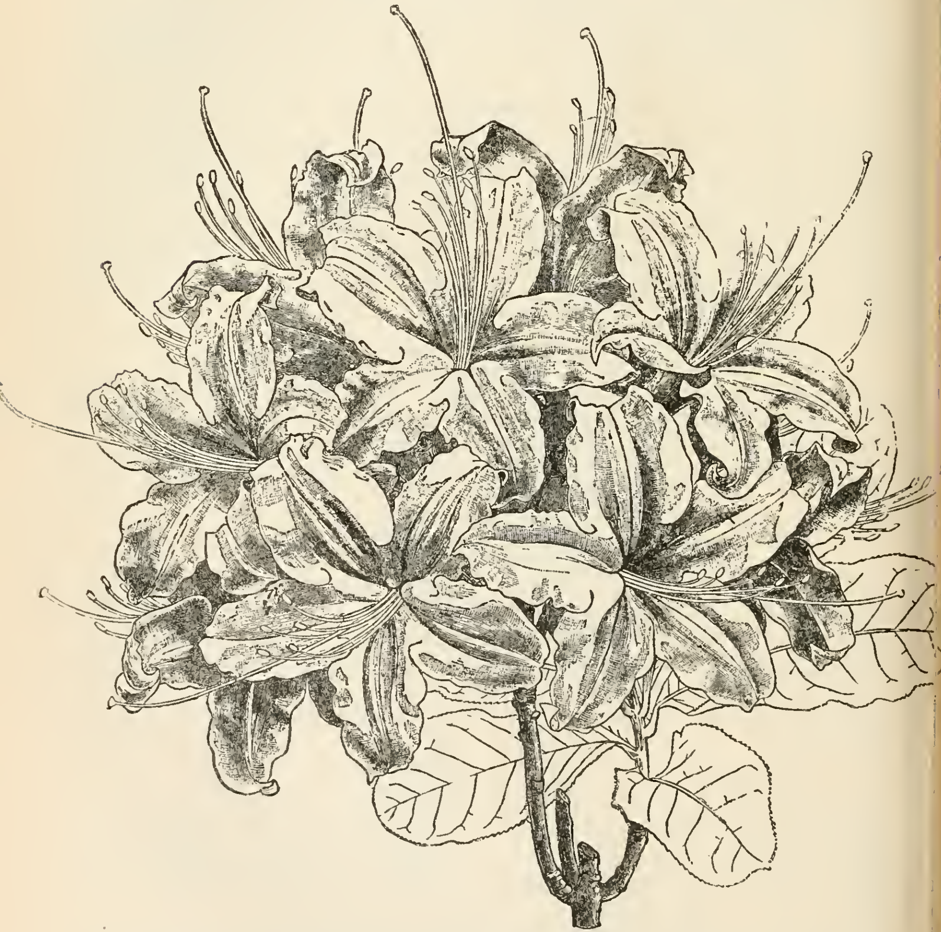

Fig. 379. California Azalea (*Rhododendron occidentale*). Flowering stem. Leaves are said to be poisonous to stock. (From American Agriculturist.)

Distribution. In wooded districts along streams in California extending to the mountains east of San Diego and common northward.

Poisonous properties. The leaves of the species have been analyzed chemically and have been found to contain a poisonous substance, said in California to be poisonous to stock. Certain species of Azalea contain the glucoside *ericolin* $C_{34}H_{56}O_{21}$.

Kalmia, L.

Erect shrubs with entire evergreen coriaceous leaves; naked buds; flowers in umbels or corymbs, or solitary, or 2-3 together in the axils; calyx 5-parted; corolla somewhat wheel-shaped, 5-lobed, with 10 pouches in which 10 anthers are lodged; filaments long, stamens 10, shorter than the corolla; anther-sacs opened by large terminal pores; ovary 5-celled; ovules numerous; capsule obscurely 5-lobed, 5-celled, many-seeded; seeds small. Species 7, 6 native to North America, 1 in Cuba.

Kalmia latifolia L. Calico-bush. Mountain-laurel.

A shrub 4-8 feet high, forming dense thickets, becoming a tree 10-30 feet high in the mountains; branches stiff; leaves alternate, bright green on both sides, ovate-lanceolate or oblong petioled; flowers profuse, large, and showy, tip rose-color to nearly white, in terminal corymbs; capsule depressed, globose, 5-lobed, glandular.

Distribution. Rocky hills, damp soil. Canada to Maine and the Allegheny Mountains, through West Florida, Ohio, Kentucky, and Tennessee.

Poisonous properties. This plant has long been known as poisonous, and is very much dreaded in the Alleghany Mountains. The substance *andromedotoxin* $C_{31}H_{51}O_{10}$, referred to elsewhere, has been found in all parts of the plant. Prof. Chesnut, in reference to the plants says:

> Scores of cattle and sheep are poisoned annually by eating the shrub. Access to it is generally obtained by breaking away from inclosures, or through neglect or accident when cattle or sheep are being driven past laurel thickets to upland pastures in early spring. Laurel leaves (commonly used for decorative purposes in winter), or the flowering branches, are often carelessly thrown into inclosures where animals are kept. The older cattle are not so frequently killed by it, but they are by no means immune. Horses and even goats have died from eating the leaves and in May, 1895, a monkey was killed at the National Zoological Park, at Washington, D. C., by eating a few flowers and leaves offered to it by a visitor. Deer and grouse are said to be immune, although it is claimed that their flesh, especially that of the ruffed grouse, is poisonous when they have fed upon it. It is stated that chickens have been poisoned by eating the vomited matter from poisoned animals. Experiments show, however, that they are able to withstand considerable quantities of the pure poison when it is fed to them. In these experiments the chickens were killed with chloroform after dosing for a few days. The entrails were then cast aside, and the well-boiled meat was fed to cats with nearly fatal results. The honey derived from the nectar of the flower appears to be poisonous under some conditions. Cases of human poisoning occur indirectly in the ways indicated above; directly by overdoses or improper use in domestic medicine, probably by the secret and criminal use of the leaves to increase the intoxicating effects of liquors, and, in children, by their eating the young shoots by mistake for the wintergreen (*Gaultheria procumbens*).

Dr. Johnson refers to the poisonous properties of the plant as follows:

> "The leaves of the plant as also those of *Kalmia angustifolia* (Sheep-Laurel, Lamb-kill) are said to be poisonous to sheep and calves; and cases are reported of men being poisoned by eating the flesh of partridges which had fed upon the buds and berries. On the other hand, Wilson, the ornithologist, ate freely of the flesh of such birds without any ill effect whatever; and deer feed upon the leaves in winter, not only without ill effect upon themselves, but also without rendering their flesh unwholesome to man. And yet the common opinion is that leaves are very poisonous. The writer himself was cautioned by an old Massachusetts farmer against

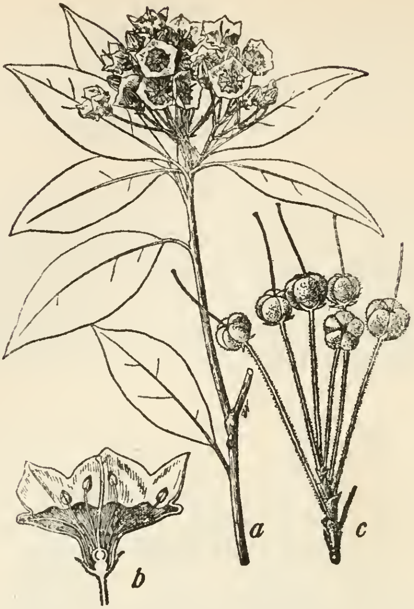

Fig. 380. Mountain laurel (*Kalmia latifolia*). a, flowering spray, one-third natural size; vertical section of flower showing peculiar attachment of stamens, natural size. c, fruiting capsules, natural size. Very poisonous. (Chesnut, U. S. Dept. Agr.)

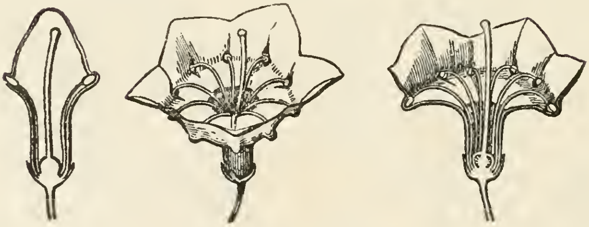

Fig. 381. Mountain Laurel (*Kalmia latifolia*). 1, section of flower bud showing anthers lodged in the pockets of the corolla; 2, expanded flower showing anthers in pockets; 3, sectional view. (Gray.)

meddling with *K. angustifolia* because of its poisonous nature; disregarding the advice, he ate several leaves in the presence of the farmer, without, however, convincing the latter, notwithstanding no ill effects were experienced. That persons have been poisoned seriously by eating the flesh of partridges in winter cannot be denied; that these birds may have fed upon kalmia buds and berries is also probable, but that their flesh is thus rendered poisonous does not seem as yet fully established. Some experimenters have reported effects produced in their own persons by strong decoctions of the leaves, similar to those of partridge poisoning; others quite as worthy of credence have failed to observe any sensible effect from them. Taking these contradictory statements in connection with the negative results of the chemical analyses thus far made, one may reasonably conclude either that the poisonous character of these plants has been greatly exaggerated, or that the energy of the poison, whatever it may be, is greatly influenced by the personal idiosyncrasy of the individual experimented with.

Dr. Millspaugh, after digesting the various opinions that have been given regarding the plant, makes this statement:

> From the experience of nearly all persons who have experimented upon themselves with a tincture or decoction of the leaves, it is obvious that the effects produced on cattle after grazing on the leaves, and on persons eating of "poisoned" partridges, are due to the plant itself, not to indigestion or putrefaction. Dr. Bigelow's later observations agree in toto with our provings. He gives the following as its action: "The flesh of the bird impairs the functions of the brain and acts directly as a sedative poison, secondarily affecting the digestive and circulatory organs." The symptoms arising in those proving the drug are: Vertigo and headache; almost complete loss of sight; pale, somewhat livid countenance; salivation and difficult deglutition. thirst, nausea and vomiting, with oppression and pressure in the region of the stomach, difficult respiration with great palpitation, and fluttering of the heart, followed by an irregular, feeble, and slow pulse; weakness, weariness and pains in the limbs; coldness of the surface and great prostration."

There would seem to be no question then that this plant is poisonous.

Kalmia angustifolia, L. Sheep-laurel. Lambkill

Shrub from 1-3 feet high; leaves usually opposite, or in 3's; pale or whitish beneath, light green above; acute or narrowly oblong, petioled; flowers in simple or compound corymbs, purple or crimson; pedicels filiform, recurved in fruit; sepals ovate, acute, capsule depressed, globose.

Distribution. In moist soil from Eastern Canada to Newfoundland, from Hudson Bay south to Georgia and Michigan.

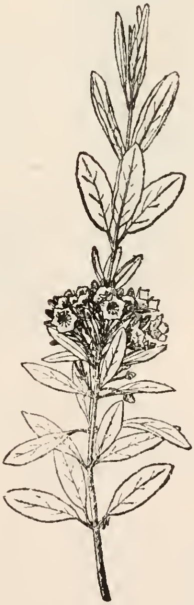

Fig. 382. Sheep-laurel (*Kalmia angustifolia*), showing flowering branch, one-third natural size. (Chesnut, U. S. Dept. Agr.)

Kalmia polifolia, Wang. Swamp laurel

A low shrub with 2-edged branchlets, opposite nearly sessile leaves; oblong and white-glaucus beneath; margins revolute; flowers in terminal corymbs, few flowered; flowers ½ inch broad, purple; capsule depressed, glabrous, smooth.

Distribution. In bogs, Newfoundland to Alaska, Connecticut to Pennsylvania, Michigan, Rocky Mountains, and California.

Poisonous properties. Both of these species are regarded as poisonous, the *K. angustifolia* especially so. The symptoms of poisoning are very much the same as those produced by the preceding species.

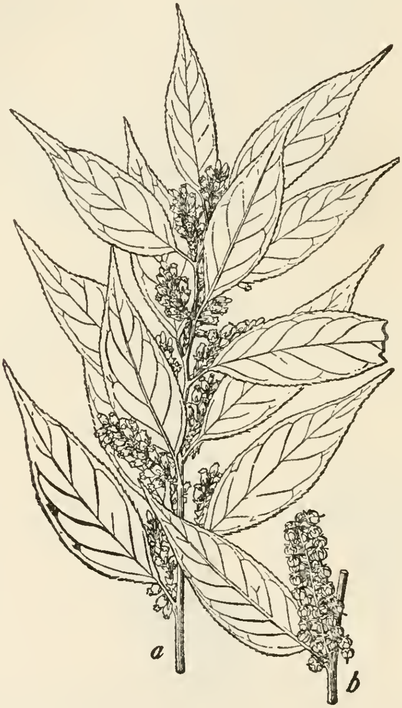

Fig. 383. Branch ivy (*Leucothoe Catesbaei*): a, flowering branch; b, fruiting capsules. (Chesnut, U. S. Dept. Agr.)

Leucothoe, D. Don

Shrubs with alternate petioled leaves, and small, usually white, flowers in axillary or terminal spiked, racemes; sepals 5, distinct; corolla cylindrical, 5-toothed; stamens 10, included; anthers naked, or the cells with 1 or 2 erect awns at the apex, opening by a pore; capsule depressed, more or less 5-lobed, 5-celled, 5-valved; seeds mostly pendulous, minute. About 35 species, natives of the Western Continent; a few in Asia.

Leucothoe Catesbaei, (Walt.) Gray

Shrubs 2-4 feet high; leaves ovate-lanceolate; taper-pointed; serrulate, evergreen, with spinulose teeth; racemes dense, many-flowered; bracts borne at the bases of the short petioles; corolla narrowly cylindric; anthers awned; capsules depressed.

Leucothoe racemosa, Gray

Shrubs 4-10 feet high; branches and racemes mostly erect; leaves oblong to ovate, generally acute at each end; sepals ovate-lanceolate; anther cells 2-awned; stigma capitate; capsule depressed-globose; seeds smooth and wingless.

Distribution. Moist thickets and swamps from Massachusetts, to Florida, and Louisiana.

Poisonous properties. Both species are known to be poisonous in the Alleghany Mountain region to all kinds of stock; probably contain the same principles found in other plants of this order.

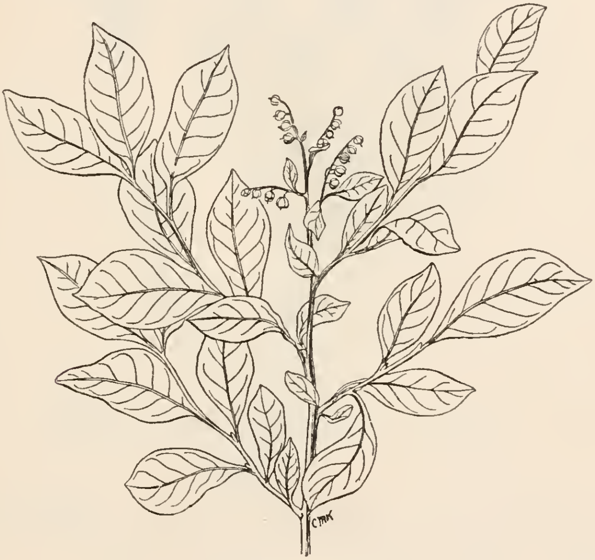

Fig. 384. Swamp Leucothoe (*Leucothoe racemosa*). A well known poisonous plant of the Alleghany Mountain region and the Southern states. (Charlotte M. King.)

Andromeda, L

Shrubs or small trees; leaves evergreen, short petioled; flowers in panicles, racemes or umbellate clusters; calyx persistent, without bractlets; corolla globose, urn-shaped, 5-parted; stamens 10, included; anthers fixed near the middle and opening by a pore; ovary 5-celled with columnar style; capsule globular and 5-celled, many seeded; seeds smooth. A small genus of 13 species found in Eastern Asia, the Himalayas, North America and Europe.

Andromeda Polifolia L. Wild Rosemary. Fetter-bush

A glabrous shrub 6-19 inches high, coriaceous; leaves with strongly revolute margins, glaucus beneath; flowers in few-flowered drooping umbels; bracts persistent; calyx lobes triangular; corolla urn-shaped; stamens 10, anther with a slender terminal awn.

Distribution. From Newfoundland to New Jersey; Michigan to British Columbia and Alaska; Europe and Asia.

Andromeda floribunda, Pursh. Mountain Fetter-bush

A leafy shrub from 2-6 feet high; branches nearly erect, bristly strigose pubescent; leaves oblong to ovate-lanceolate, ciliate and glandular dotted beneath; flowers white in densely flowered panicles; corolla 5-angled; stamens 10; anthers without appendages; capsule somewhat globose, shorter than the style.

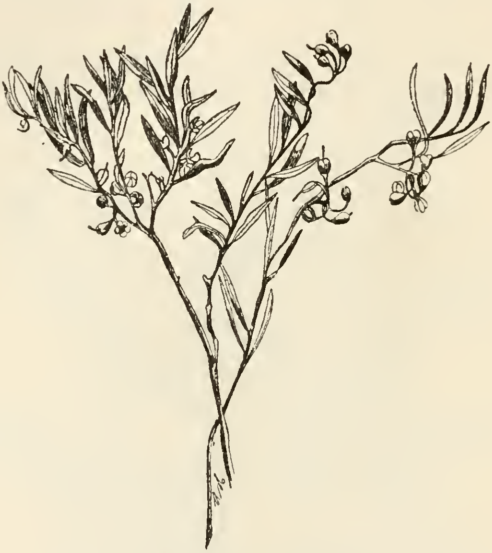

Fig. 385. Andromeda (*Andromeda Polifolia*). Common in the North, especially in bogs and swamps. (Ada Hayden.)

Distribution. In the mountains of Virginia to Georgia.

Lyonia, Nutt

Shrubs. Leaves coriaceous and evergreen or thin and deciduous; flowers in racemes or panicles, white; calyx of 5 nearly distinct sepals; stamens 5; filaments hairy and often toothed or appendaged; anthers unappendaged; capsule 5-angled, dorsal suture with a thickened ridge; seeds with a thin testa.

Lyonia mariana, B. & H. Stagger-bush

A glabrous shrub with black dots, from 2-4 feet high; oblong or oval leaves, smooth above, slightly pubescent on the veins; flowers in nodding fascicles, racemose on nearly leafless branches; segments of calyx acute; corolla ovoid, white or pinkish; stamens 10; anther filaments 2-toothed near the apex; capsule ovate, as large as the sepals.

Distribution. Low grounds from Rhode Island to Florida, Tennessee and Arkansas.

Poisonous properties. All three species are poisonous. The leaves of the fetter-bush contain a narcotic poison, the *andromedotoxin* $C_{31}H_{51}O_{10}$, and have been known to kill sheep. Sheep have also been poisoned by the mountain fetter-bush. The stagger-bush received its name because of the intoxicating effect of its leaves on sheep and cattle.

PRIMULALES

Herbs or shrubs; corolla mostly present, gamopetalous; stamens borne on the corolla as many as its lobes or twice as many or more. The family *Plumbaginaceae* contains *Statice*, growing mostly in saline soil along the coast. It is used as an astringent, particularly in diarrhoea. The baycurn (*Statice brasiliensis*) is one of the most powerful astringents, and is used locally as a gargle.

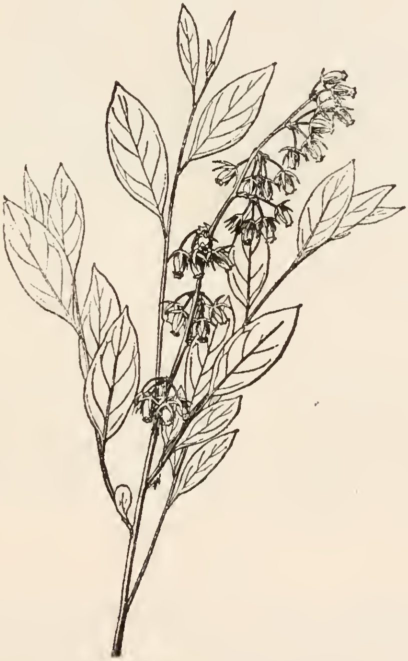

Fig. 386. Stagger-bush (*Lyonia mariana*), showing flowering branch, one-third natural size. It contains a narcotic poison. (Chesnut, U. S. Dept. Agr.)

PRIMULACEAE. Primrose Family

Herbs with simple leaves and regular flowers; calyx 5-parted; stamens as many as the lobes of the gamopetalous corolla and borne upon it; ovary 1-celled, bearing several or many seeds; calyx free from the ovary or partly adherent A small order with about 28 genera, and 350 species, of wide distribution in the northern hemisphere, many of them arctic.

Few of the members of this order are weedy, or at least they are not troublesome. The honeywort (*Lysimachia Nummularia*) has escaped from gardens into damp ground and occasionally some species of the loosestrifes, are troublesome as weeds. Several members of this family are cultivated for ornamental purposes, among which are the cowslips or primroses and cyclamens. Native species of *Steironema,* like *S. lanceolatum,* and *Lysimachia,* are pretty ornamental plants. One of the prettiest of the native species in the northern states is the American cowslip (*Dodecatheon Meadia*), which is stemless and has a 6-parted reflexed corolla and exserted stamens. The true primroses (*Primula*) are frequently cultivated, the *P. sinensis* and *P. obconica* in greenhouses. The English cowslip, *P. vulgaris,* is an interesting European plant, and is also found in high altitudes in North America. The beautiful *P. Parryi,* of the Rocky Mountains, is abundant along brooks and in moist meadows at high altitudes, and is one of the prettiest of the Rocky Mountain plants. The rootstock has a strong odor of musk and is said to be somewhat poisonous. The leaves of *P. obconica* are poisonous to the touch, being similar in effects to the poison ivy, although not so strong. The European cyclamen is a commonly cultivated plant in greenhouses. The pimpernel or poor man's weather-glass (*Anagallis arvensis*) is common in sandy soil and occasionally somewhat weedy. It is native to Europe. In *Primula* and cyclamen is found *cyclamin,* $C_{25}H_{42}O_{12}$, with which *primulin* is supposed to be identified.

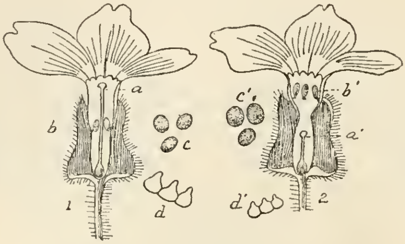

Fig. 387. Long and short-styled flowers of Primula. *a* and *b* styles; *c* pollen grains, and *d* papillae of short-styled flower. Modified by C. M. King, after Strasburger.

Anagallis, L.

Herbs with alternate, sessile, or short-petioled whorled leaves; flowers solitary, on axillary peduncles; calyx 5-parted; corolla wheel-shaped, deeply 5-parted; longer than the calyx; stamens 5; filaments bearded; capsule globose, circumscissile, many-seeded; seeds minute, flat on the back. About 15 species, mostly in the old world.

Anagallis arvensis, L.

Annual; leaves ovate, or oval, membranous, sessile, or somewhat clasping; calyx-lobe keeled, shorter than the obovate corolla-segments, fringed with minute stalked glands; flowers scarlet or white, usually with a darker center; capsule smooth.

Distribution. Newfoundland to Minnesota, Mexico, and on the Pacific Coast. Naturalized from Europe.

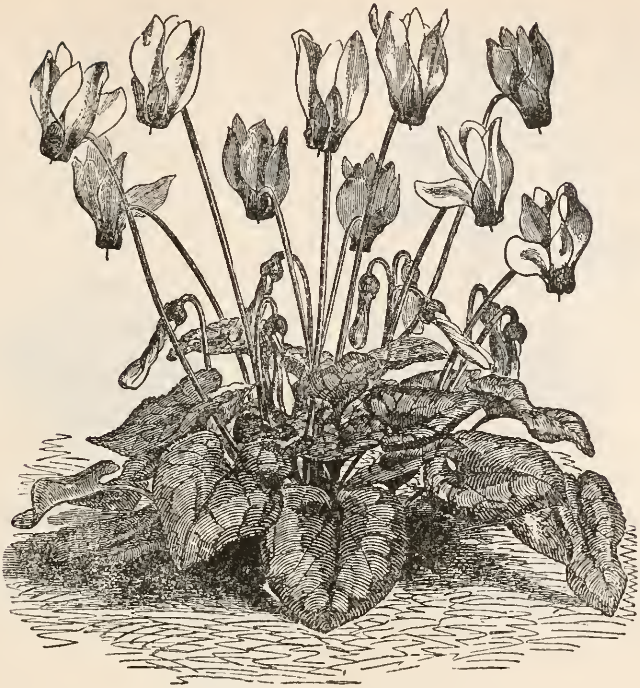

Fig. 388. Persian Cyclamen (*Cyclamen*). Frequently cultivated in greenhouses. (From American Agriculturist.)

Poisonous properties. This plant is especially common on the Pacific Coast, where it is well known as "Poison weed," and according to Prof. Chesnut, is suspected of having caused the death of a horse at Santa Ana. It contains the glucoside *cyclamin* $C_{25}H_{42}O_{12}$, and a saponin-like substance, also a pepsin-like ferment. According to Hyams, the fluid extract in 4 drachm doses is fatal to dogs.

Primula, L.

Perennial scapose herbs, producing a tuft of basal leaves; flowers dimorphous, umbellate, or in bracted racemose whorls; calyx tubular, angled, 5-cleft, persistent; corolla funnelform or salverform; tube longer than the calyx; stamens 5, included; capsule many-seeded, splitting at the top into 5 or 10 valves. About 150 species, mostly in the northern hemisphere. This species is rather rare in eastern North America, but one species, (*P. Parryi*), is abundant in higher altitudes of the Rocky Mountains, and is suspected of being poisonous.

Primula obconica. Hance. Primrose

Leaves all radical and ovate-cordate; slender scapes 6-12 inches long; flowers blush-lilac or purple, frequently drooping; calyx saucer-shaped and shallow; petals deeply notched, obconical.

Distribution. Native to China, but frequently cultivated in greenhouses.

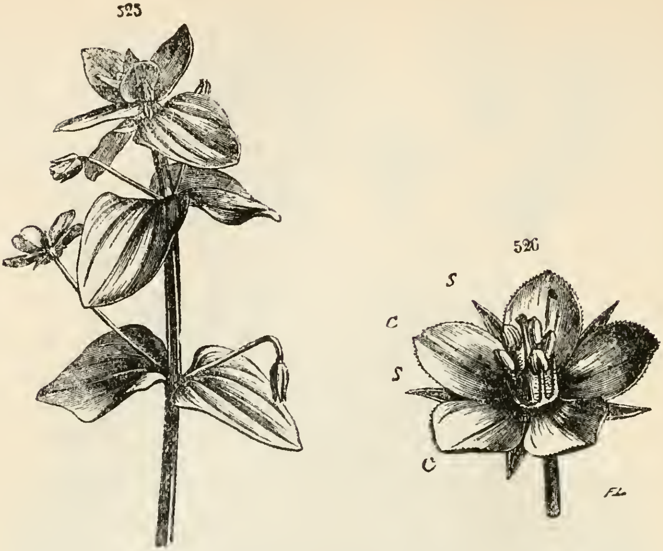

Fig. 389. Poison weed (*Anagallis arvensis*). Flowering branch. Flower. *c*, corolla; *s*, sepals. Poisonous to horses and dogs. (From Vesque's Traité de Botanique.)

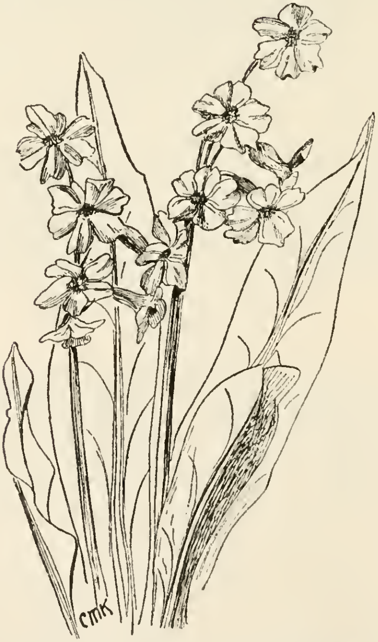

Fig. 390. Parry's Primrose (*Primula Parryi*). This primrose is common in high altitudes. The roots have a more or less musky odor and it is regarded as poisonous. (Charlotte M. King.)

Poisonous properties. *Primula obconica* and *P. sinensis* both contain *embelic acid* $C_7H_3O_2(OH)_2C_{11}H_{23}$. It has long been known that some people are sensitive to poisoning by coming in contact wiht the leaves of *P. obconica.* The hairs act as an irritant poison. Dr. White calls attention to the injury as follows:

> The cutaneous disturbance therein described, dermatitis venenata, subsided in a short time, and the skin of the three affected persons has remained in a healthy condition until recently. Within the last two or three weeks, however, they have all manifested a recurrence of the same symptoms, an eczematous inflammation of the hands and face, and in about the same degree as last year. They now feel assured that the trouble is caused by *Primula obcónica*, for the condition did not develop until a few days after this plant was first offered for sale in the shop, where it was freely handled by them. The proprietor informs me that his hands and face became affected immediately after making it up into dinner-table decorations.

Dr. Thurber refers to a case of poisoning quoted by Mr. Meehan:

> A person, who after potting a lot of *Primula obconica*, had his face so swollen that he remained completely blind for a day. This was the severest case yet reported; but it should be stated that Mr. Cliffe was at that time suffering from poisoning by *Euphorbia pulcherrima.*

Mr. Thurber says:

> Some have likened the effects produced by *Primula obconica* to those of *Rhus Toxicodendron*, the Poison Ivy, but it is a well established fact that many persons are poisoned by *Rhus* without coming in contact with the plant. Merely passing near it or being near a fire where it is being burned is sufficient to cause serious poisoning, indicating that the active principle is volatile.

EBENALES

Shrubs or trees, with alternate simple leaves; flowers generally regular; calyx more or less adnate to the overy; corolla gamopetalous or sometimes polypetalous; stamens as many as the lobes, with corolla opposite them or more numerous.

FAMILIES OF EBENALES

Stamens as many as the corolla lobes.............................Sapotaceae
Stamens twice as many as the corolla lobes.
  Flowers dioecious or polygamous.............................Ebenaceae
  Flowers perfect .... Styracaceae

SAPOTACEAE. Sapodilla Family.

Shrubs or trees with milky juice; simple and entire, alternate leaves; small and perfect, regular flowers; persistent sepals 4-7; corolla gamopetalous; tube 4-7 lobed, frequently with as many or more lobe-like appendages; stamens as many as the proper lobes of the corolla; fruit a fleshy drupe, generally 1-celled and 1-seeded; seed large, coat hard; endosperm fleshy or none.

A small order of 35 genera and 400 species, of tropical regions. But few of these occur in the United States, the most common in the southern states being the Southern buckthorn (*Bumelia lycioides*) and *B. lanuginosa,* both being common in the woods from Illinois southward. The star apple (*Chrysophyllum Cainito*) with a fruit about the size of an apple, has a pleasant flavor, but is said to be very constipating. The sapodilla plum (*Achras sapota*) also native to the West Indies, is widely cultivated in the tropics for its fruit, which is about the size of a pear and inferior only to the orange. The marmalade (*Lucuma mammosa*) of tropical America, from 3 to 5 inches long, is much esteemed for its pulpy fruit. The leaves, however, contain *pumic acid,* which is often used to adulterate cola nut. The fruits of the cainito (*Lucuma obovata*) a native of Peru and Chili, are also eaten, as are the fruits of the black bully tree (*Dipholis salicifolia*) of Jamaica. Seeds of the buttertree (*Bassia butyracea*) furnish an oil which is an article of some commercial importance in India. The seeds of the buttertree (*Butyrospermum Parkii*) of South Africa, furnish an oil which is used as food by the natives. Gutta-percha (*Dichopsis Gutta*), of Borneo, and the Malayan Peninsula is the source of some of the Gutta-percha of commerce, which is used in surgical dressing, the same sub-

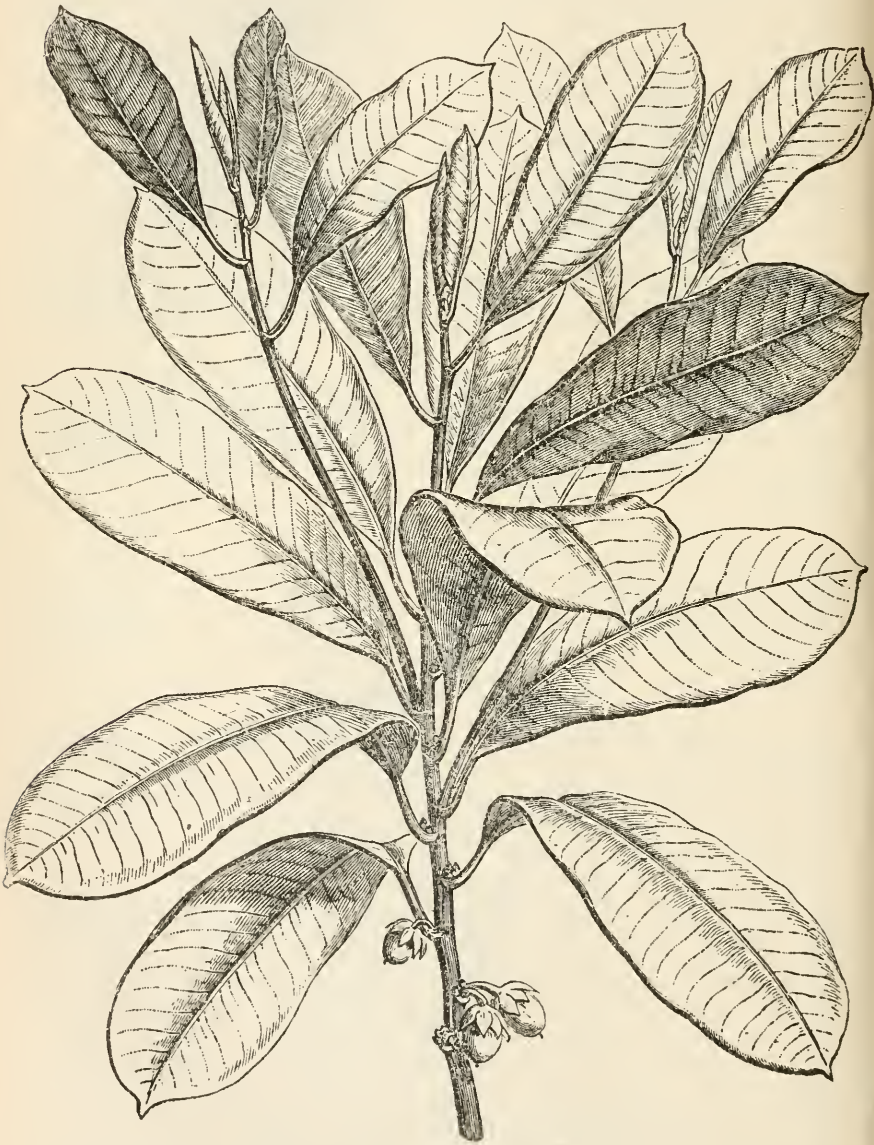

Fig. 391. Gutta-percha Tree (*Dichopsis Gutta*). The gutta-percha of commerce is obtained from the latex of this tree. (After Faguet.)

stance being also obtained from *Mimusops Kauki,* a large tree, native of British Guiana. The former contains *gutta* $C_{10}H_{10}N$, *fluavil* $C_{10}N_{11}O$, and *alban* $C_{40}H_{64}O_2$. *Sapotin* $C_{29}H_{22}O_{20}$ occurs in the bark of *Achras Sapota* and of *Symplocos racemosa.* In lotus bark occur three basic substances: *loturin, colloturin* and *loturdin.* In the seeds of *Illipe Maccleyana* a toxic glucoside, $C_{17}H_{32}O_{10}$, is found.

The *Sapotaceae* or Sapodilla family contains a number of plants of economic importance in the tropics; among these are *Mimusops Kauki, Dichopsis Gutta, Palaquium oblongifolium,* of the East Indies, and other species which furnish gutta percha. This is obtained from the latex of these plants and because of its plasticity, is particularly valuable in the manufacture of surgical instruments and for temporary filling of teeth. The same substance is produced by *Sideroxylon tomentosum* and *Payena.* The Sapodilla tree (*Achras Sapota*) of Yucatan produces an aromatic gum resin which is largely used in the manufacture of chewing gum. Vegetable butter is obtained from the seeds of *Bassia butyracea.* The Sapodilla or Sapote (*A. Sapota*) is commonly cultivated in the tropics, especially the West Indies and Central America, for its wild fruit. The star apple, *Chrysophyllum Cainito,* also produces a valuable fruit. Hard iron woods are produced by *Mimusops Kauki* of Australia and *Argania Sideroxylon* of Morocco. Saponin-like substances are produced by several plants of the family such as *Omphalocarpum procerum.* The *Lucuma salicifolia* and *Payena latifolia* contain hydrocyanic acid.

EBENACEAE. Ebony Family

Trees or shrubs with very hard wood, alternate entire leaves and polygamous regular flowers; stamens from 2-4 times as many as the lobes of the corolla; ovary 3-12 celled; ovules 1-3 in each cavity; fruit a several-celled berry; seeds mostly single in each cell, large and flat, with a smooth coat.

About 6 genera and 275 species. The most widely distributed tree in the United States is the common persimmon (*Diospyros virginiana*), a tree from 20-70 feet high, found in woods and old fields from Rhode Island to New York and southern Iowa. The fruit is commonly eaten and the unripe fruit is used in medicine for internal hemorrhage. The Japanese persimmon (*D. Kaki*) with small flowers and a greenish-yellow fruit, of variable size and shape, is cultivated in the Southern States and California for its fruit, which is delicious. In Egypt it is cultivated under the name of Lotus tree.

The Indian persimmon (*D. Embryopteris*) is a middle-sized evergreen tree native from India to Java, and is used in India in medicine, especially for chronic dysentery. Ebony wood comes from several species like the Ceylon ebony, Indian ebony (*D. Ebenum*) and (*D. melanoxylon*), and is highly prized for furniture since it is hard and black. The calamander wood (*D. quesita*) of Ceylon is a hard wood prized for making boxes. The mangosteen or mabola (*D. discolor*), a native of the Philippine Islands, is now commonly cultivated in the tropics for its fruit, which is about the size of a quince and has a pleasant flavor. Other hardwooded trees are *D. Cargillia* and *D. pentamera,* natives of New South Wales.

Ebony wood is of various colors; the black from *D. ebenum;* red ebony from *D. rubra,* native of Mauritius; white ebony from *D. chloroxylon.* Other species of Diospyros furnish a striped ebony, and others a green.

Styracaceae. Styrax Family.

Mostly tropical shrubs or trees with regular perfect, or polygamo-dioecious flowers; calyx free or adherent to the ovary; corolla gamopetalous, or polypetalous; the lobes or petals 4-8; stamens twice as many as the lobes of the corolla, or more, inserted on its tube or base; the filaments monadelphous, or in 4-5 sets; style 1; ovary 2-5-celled; fruit a berry or drupe.

About 75 species and 7 genera, few of them native to the United States. Several species are cultivated for ornamental purposes, especially the snowdrop or silver bell tree (*Halesia carolina*) which is a small tree native to the southern states. *Styrax Benzoin* is obtained from Sumatra and Java, benzoin being obtained by cutting incisions into the plant, from which a resin exudes and soon hardens by exposure to the air. *Benzoin* is used chiefly as incense in the service of the Greek Church.

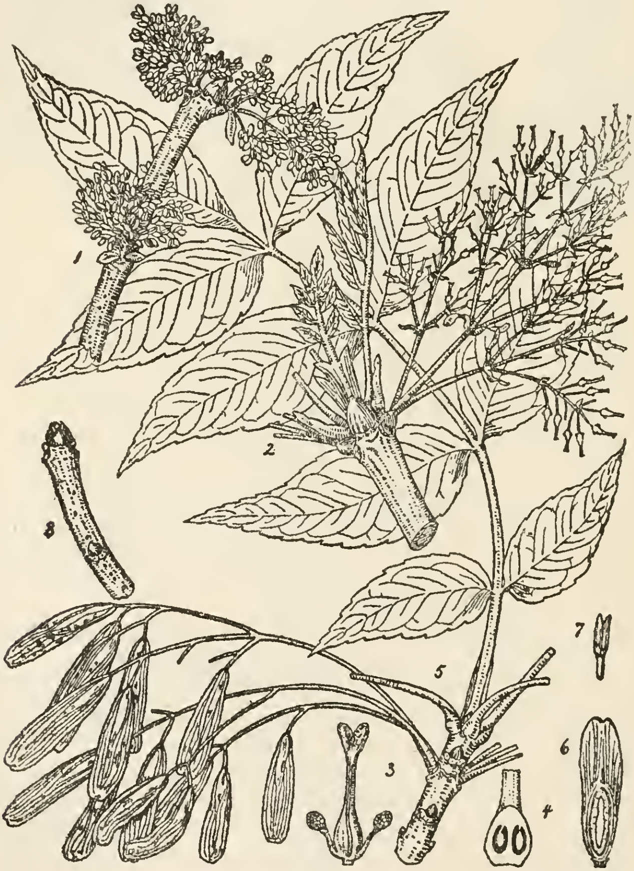

Fig. 392. Black Ash (*Fraxinus nigra*). 1. Flowering branch of staminate tree. 2. Flowering branch of pistillate tree. 3. Pistillate flower showing rudimentary stamens, enlarged. 4. Longitudinal section of ovary, enlarged. 5. Fruiting branch. 6. Longitudinal section of fruit. 7. Embryo. 8. Winter branchlet. 1, 2, 5, 6, 8, one-half natural size. (M. M. Cheney in Green's Forestry of Minnesota.)

Styracin, $C_9H_{10}O_7$, one of the ketones, occurs in *Styrax Benzoin,* also resin, *benzoic acid* $C_7H_6O_2$, and *cinnamic acid* $C_9H_8O_2$. Siam benzoin contains *vanillin.*

CONTORTAE

Herbs, shrubs or trees; leaves opposite or rarely alternate; flowers regular; corolla gamopetalous, rarely polypetalous or wanting; stamens generally borne on lower part of corolla when present, as many as the lobes or fewer; ovaries 2, distinct.

FAMILIES OF CONTORTAE

Corolla none; stamens usually 2..................................Oleaceae
Corolla present, regular; stamens as many as its lobes.
  Ovary 2; stigmas and sometimes styles united; fruit a follicle.
    Stamens distinct ....Apocynaceae
    Stamens monadelphous attached to a stigmatic body......Asclepiadaceae
  Ovary compound, 2-celled.................................Loganiaceae
Ovary 1-celled ....Gentianaceae

OLEACEAE. Olive Family

Trees, shrubs, or some nearly herbaceous; leaves opposite or rarely alternate, simple or pinnate without stipules; flowers in panicles, cymes or fascicles; calyx small, inferior, sometimes wanting; stamens 2-4; filaments separate; ovary superior, 2-celled; ovules a few in each cavity; style short or none; fruit a capsule, berry or drupe. About 500 species. Contains the lilacs (*Syringa vulgaris, S. persica*), the jasmine (*Jasminum grandiflorum*) cultivated in France as the source of a valuable perfume; the fringe tree (*Chionanthus virginica*), well known in cultivation, and the ashes which make valuable timber trees like green ash (*Fraxinus pennsylvanica, var. lanceolata*), white ash (*F. americana*), black ash (*F. nigra*) and manna of Europe, *F. Ornus.* The sweet exudate is called manna which contains *mannetol* and a glucoside resembling *aesculin.*

The olive (*Olea europaea*) of the Mediterranean region, is cultivated extensively in southern Spain, France, Italy to Arabia, California, and other warm countries. The unripe fruit is used for table purposes by steeping in water containing lime and ash, and then pickling in a salt solution. The nearly ripe or ripe olives are used in a similar way. The seed as well as fruit contains an oil consisting of *olein* $C_3H_5(OC_{18}H_{33}O)_5$, the greenish color of which is due to the chlorophyll. It is nutritive and laxative. The hard wood takes a fine polish.

Edwards and Power have found an alkaloid in the bark of *Fraxinus americana,* one in the bark of *Olea glandulifera,* in the leaves and bark of *Ligustrum robustum,* and in the leaves of *Jasminum.* The glucoside *phillyrin,* $C_{26}H_{32}O_{11}$, occurs in *Osmanthus fragrans* and *Forsythia suspensa,* and may be converted into *phillygenin,* $C_{20}H_{22}O_6$, which may again be readily converted into *ugenol* and *vanillin. Ibo* $C_{20}H_{28}O_{19}$, a saponin-like glucoside, occurs in *Ligustrum* and *Ibotu; chionanthin* is found in the bark of *Chionanthus virginica,* and is intensely bitter. It may also contain *saponin.* The plant is probably somewhat poisonous.

Ligustrum (Tourn.) L.

Shrubs or small trees with opposite entire leaves; flowers in a terminal thyrsus or panicle; corolla gamopetalous, funnelform, tube short, the limb 4-

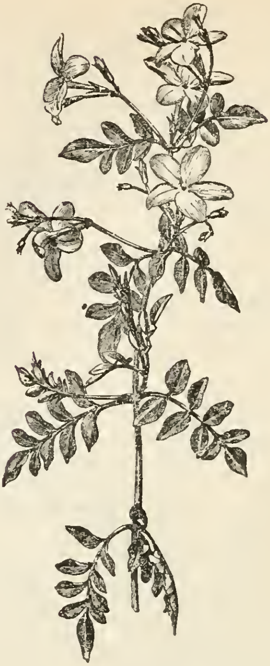

Fig. 393. Large-flowered white Jessamine (*Jasminum grandiflorum*). A native of Japan but cultivated in France as a source of perfume. (From Vesque's Traité de Botanique.)

lobed; stamens 2; filaments short; ovary 2-celled, with 2 ovules in each cavity; fruit a 1-3 seeded berry. About 35 species, natives of the Old World.

Ligustrum vulgare, L. Privet

A shrub with long and slender branches, firm leaves; smooth, lanceolate or oblong, and short petioled; panicles dense, minutely pubescent; pedicels very short; flowers white.

Distribution. Commonly cultivated for ornamental purposes, but escaped here and there from cultivation.

Poisonous properties. The leaves and fruit of the plant are said to be poisonous. Prof. Chesnut states that accidents have been occasioned to children who have eaten the fruit or the leaves. The plant contains *syringin* and the bitter glucosidal principle *syringopicrin* $C_{26}H_{24}O_{17}$. These also occur in the lilac. Edwards and Power have also found an alkaloid in the leaves and bark of an allied species, *Ligustrum robustum;* and it was discovered also to be in the seeds of *L. Ibota.*

LOGANIACEAE. Nux Vomica Family.

Herbs, shrubs, vines, or in a few tropical genera, trees; simple, opposite leaves, stipules or small membranes; flowers perfect and regular in axillary or cymose clusters; calyx of 4 to 5 parted sepals; corolla gamopetalous, 4 to 5 parted; stamens as many as the lobes of the corolla or alternate with them; fruit follicles or drupes.

About 30 genera and 400 species, in warmer regions, several of them very poisonous. *Strychnos Nux-vomica,* native to India and the islands of southern Asia, is a small straggling tree, in its native country known as the Koochia tree. The fruit resembles an orange, but with a hard rind and numerous flat

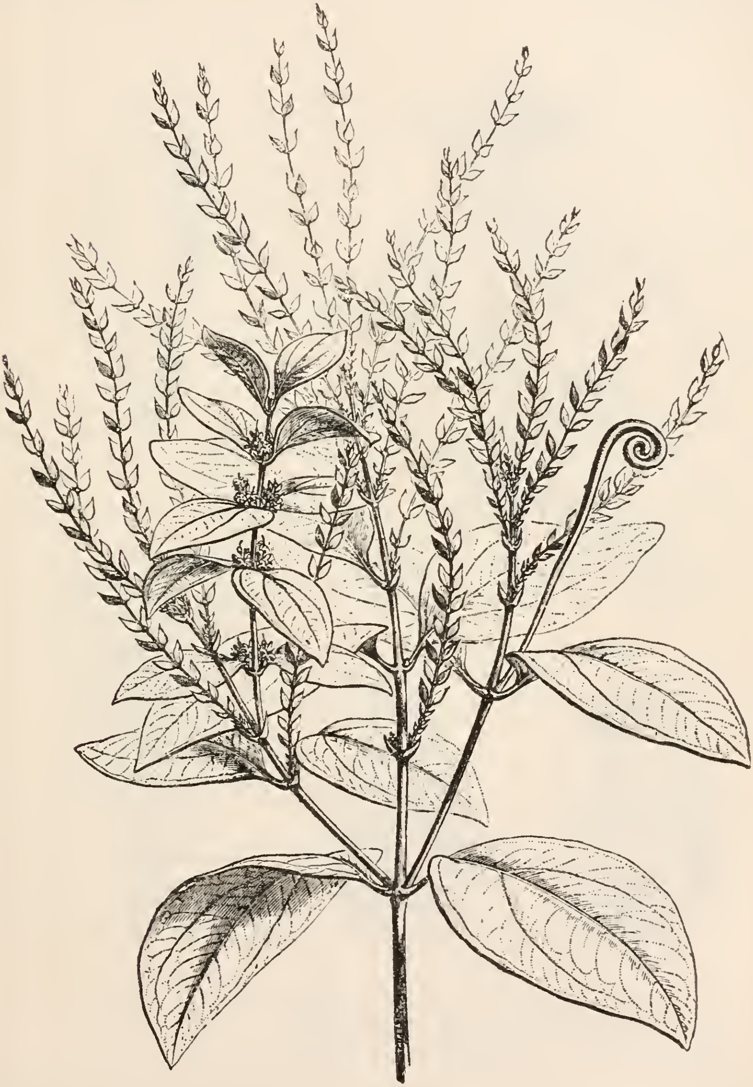

Fig. 394. Strychnos (*Strychnos Crevauxiana*). A curare plant of French Guiana. (After Faguet.)

seeds covered with silky hairs. The seeds contain two deadly alkaloids, *strychnin* $C_{21}H_{22}N_2O_2$ and *brucin* $C_{23}H_{26}N_2O_4+{}_4H_2O$. Strychnin is bitter, used as a tonic and to stimulate the circulation. The bark and root are also bitter. The natives of India use it for snake bites and fevers. This alkaloid is also obtained from other plants of this order, being extracted by water acidulated with hydrochloric acid. It has an intensely bitter taste perceptible in very dilute solution (1 in 700,000).

Delafoy has shown that starving frogs are much more sensitive to strychnin than are normal frogs.[1]

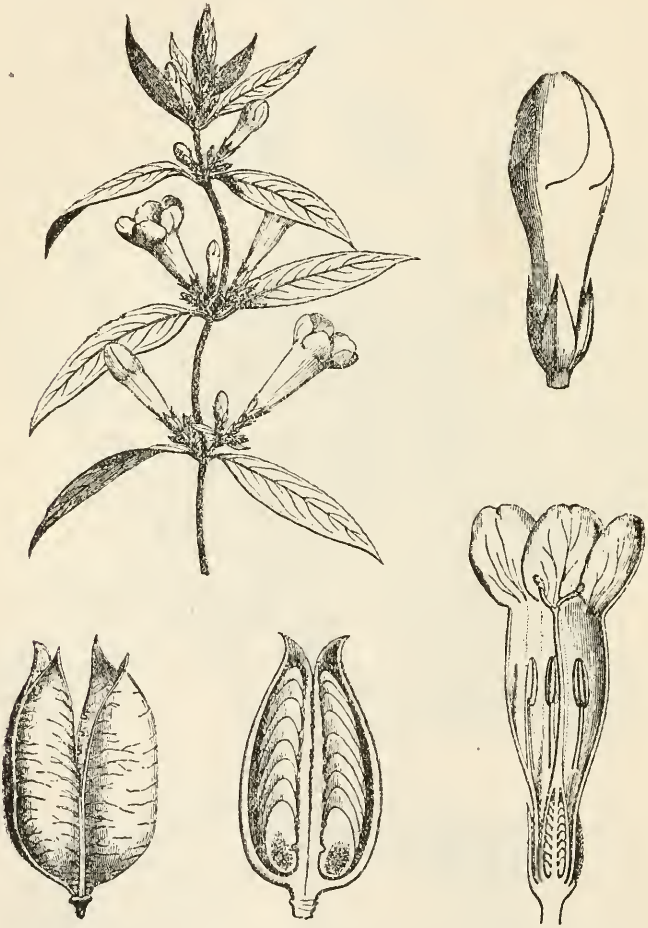

Fig. 395. Yellow Jessamine (*Gelsmium sempervirens.*) Flowering branch, bud, dehiscent fruit, longitudinal sections of fruit and flowers. Root contains poisonous alkaloid. (After Faguet.)

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[1] In a recent paper by Reid Hunt "The Effects of a Restricted Diet and of Various Diets Upon the Resistance of Animals to Certain Poisons," Bulletin Hygienic Laboratory, Public Health and Marine Hospital Service, of the U. S. Treasury Department, he reports that diet has a marked effect upon resistance of animals to certain poisons; the resistance of some

It contains the glucoside *loganin* $C_{25}H_{34}O_{14}$ especially in the pulp. The *S. toxifera* of the Orinoco, used as an arrow poison and called "curarie," or curare, is obtained from the stripped bark, which is steeped in water. It contains the alkaloid *curarin* $C_{19}H_{26}N_2O$. Other alkaloids found in curare are *protocurin* $C_{20}H_{23}NO_3$ which is poisonous, *tubocinarin* $C_{19}H_{21}NO_4$ and *curin* $C_{18}H_{17}NO_3$. The dried seeds of *S. potatorum* are used for clearing water. The *Tieute* of Java is a strong poison causing tonic and clonic convulsions and there is no known antidote. It is used as an arrow poison. *S. Crevauxiana* of French Guiana is used as a curare poison.

Dr. Winslow describes the toxicological effect of strychnin on a dog as follows:

> One-twentieth of a grain of strychnin nitrate, injected subcutaneously by the writer into a dog weighing 25 lbs., caused uneasiness and excitement, with protrusion of the eye-balls, and in the space of ten minutes, tetanic convulsions. The breathing was shallow and almost imperceptible, the pulse rapid and irregular, the lips were covered with foam, the tail was stiff and extended, the ears laid back, and there was general muscular rigidity, the animal lying on his side in a state of opisthotonos. This condition lasted about three minutes, and was followed by a period of relaxation. But the slightest noise or irritation of the skin brought on convulsions. The convulsions became less frequent and violent, and ceased altogether within half an hour. The same animal was given gr. 1-40 of the alkaloid on the following day, but without producing any appreciable result. One-tenth of a grain, given on another day and in the same manner, caused immediate uneasiness and restlessness, and in ten minutes induced a severe convulsion, lasting for three minutes, in which the animal was so rigid that he could be lifted bodily without bending. The ears were drawn back, the limbs were extended and stiff, the tail was straight and rigid, and there was twitching of the muscles of the jaw and limbs. The corners of the mouth were drawn back (risus sardonicus), the mouth was covered with foam, and there was some trismus. The breathing was nearly suppressed, owing to tetanic spasm of the respiratory muscles. Following this convulsion, the jaw dropped, the muscles relaxed and another attack could not be produced by noises or external irritation. Some twitching of the temporal muscles persisted. Evidently the second stage of poisoning had ensued, and the motor nerves and cells of the inferior cornua had become paralyzed. Death occurred in general paralysis within half an hour, and without any recurrence of convulsions or tetanic condition. Death takes place more commonly in strychnin poisoning from asphyxia, during a convulsion, and is caused by spasm of the respiratory muscles, or, more rarely, by spasm of the glottis. Sometimes a fatal result ensues from exhaustion, between the paroxyms, and occasionally death appears to follow the intense action on the nervous system, and depression of the heart.
>
> The lethal dose for dogs has been set at gr. 1-6—gr. 1-3 (Kaufmann). This is much too large, as evidenced by the experiment mentioned above. The fatal amount varies greatly in accordance with the weight of the animal; probably less than gr. 1-20 would kill toy terriers, and cases are reported where they have been destroyed by gr. 1-60 of the alkaloid. The therapeutic dose should, therefore, be proportioned, as advised, to the weight of the animal. Five to eight grains of nux vomica will kill a dog.

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animals must be increased forty-fold by changes in diet. It was found that diet causes distinct, but not very marked, differences in resistance to morphin. The experiments further show that foods such as enter largely into the daily diet of man have most pronounced effect upon resistance of animals to several poisons. They produce changes in metabolism but are not readily detectable by means ordinarily used in metabolism studies. Diet causes distinct but not very marked differences in resistance to morphin. It was found by Hunt that the effect of oatmeal diet in increasing the resistance of certain animals to acetonitrile is probably due in part to a specific effect of the diet upon the thyroid gland. The poisonous action of acetonitrile, according to Hunt, is largely due to the formation of hydrocyanic acid from it. This is the view expressed not only by Dr. Hunt, but also by Heymans and Masoin.

In the paper by Dr. Hunt referred to above, a statement is taken from the work of Mansfield that starving rabbits are much more susceptible to chloralhydrate, paralehyde, and morphin than well nourished ones. Lewin stated that starving animals are more resistant to quinin, atropin, and nicotin, than well nourished ones. Salant and Rieger found the resistance of rabbits to caffein to be diminished when the animals were starving for four or five days. The fatal dose was about 30 percent less than in well fed rabbits. In this connection it is also of interest to state that Hunt found that season has an important effect upon the resistance of animals to certain poisons. In some cases these effects seem to depend upon seasonable variations in the activity of the thyroid.

Foster, who experimented with dogs and ricin, found that when dogs were kept upon a high protein nutrition all died from 1 mgm. ricin per kilo, and of three kept on medium low plane of protein nutrition, two survived this dose.

The minimum fatal dose of strychnin for man is one-half a grain. Usually four to seven grains constitute a lethal quantity, but recovery has ensued following the ingestion of 22 grains, after a full meal.

Horses—The toxic symptoms in horses resemble those already described in the dog. They do not appear for some time (20 minutes to 6 hours), depending on the rapidity of absorption when the drug is swallowed, and include excitement, muscular spasm and convulsions, increased frequency of the pulse, and difficult respiration. Death occurs in convulsions or in the interim between them. The minimum fatal dose of strychnine, when given under the skin, is about 1½ to 3 grains, and when swallowed, 3 to 5 grains of the alkaloid, or 1 to 2 ounces of nux vomica.

Cattle are similarly affected with horses and dogs. There are exhibited muscular spasms, frequent pulse, difficult respiration, sensitiveness to light, sounds and external stimuli, protrusion of the eye-balls and convulsions. The fatal dose, by the mouth, varies greatly owing to difficulty of absorption in the complicated and capacious digestive apparatus of these ruminants. This is true of all medicines. When given under the skin, the lethal dose is a little larger than that for horses. The fatal dose for swine is said to be from gr. 1-6-gr. ¾. Chickens are comparatively insusceptible; also guinea pigs and some monkeys.

Strychnin poisoning differs from tetanus in the fact that muscular rigidity is continuous in the latter, but disappears to a considerable degree, if not completely, in the periods between the convulsions, in the case of strychnin poisoning. Moreover, in tetanus the body and limbs are less, and the jaw more affected; while in strychnin poisoning the condition is reversed.

Treatment—The treatment embraces the use of chemical antidotes, as iodine or its salts, or tannic acid; animal charcoal and emetics or the stomach tube, before absorption has occurred. The best physiological antidote is chloral in large doses per rectum. Chloroform and nitrate of amyl may also be given by inhalation, and quiet and rest enforced. Artificial respiration is of no service on account of the muscular spasms, unless air be forcibly driven into the trachea through a canula. Calabar bean and gelsemium both depress the inferior cornua, but neither is of much value in strychnin poisoning.

A large number of the cases of poisoning are fatal; according to Schauenstein 62 out of the 130 reported by him proved fatal. According to Falk, the minimum lethal dose is as follows: .6 mgrm. *strychnin nitrate* for rabbit per kilogramm; cats, .75 mgrm; frogs, 2 mgrm. In one case ½ grain *strychnin sulphate* produced death in 20 minutes, in another case 7/10 grain was required. The so-called vermin killers contain *strychnin*.

Strychnin is the best remedy to stimulate the action of the heart, and to promote appetite and digestion. It is valuable in chronic tympanites of cattle.

The St. Ignatius or False Angustura Bark (*S. Ignatii*) of the Philippine Islands, much used in medicine in the Philippines, contains the same substance as *S. Nux-vomica*. The *S. malaccensis* of Tonquin is used as a remedy for leprosy. Pink root (*Spigelia marilandica*) is a perennial herb; with opposite sessile leaves; tubular funnel-form corolla, red outside, yellow within; 6 stamens; slender style; short 2-celled capsule; found from Ohio to Florida and Texas. It contains a volatile alkaloid *spigelin* resembling *coniin* and a bitter acrid principle. It is a powerful anthelmintic. According to Hyams, when taken in overdoses it excites the circulation, causes dimness of vision, vertigo, dilated pupils, spasms of facial muscles and general convulsions, followed by death. It is especially fatal to children. Dr. True reported the plant to be poisonous. According to Dr. Stockberger this is frequently adulterated with *Ruellia ciliosa* (East Tennessee Pink-root). The prepared drug may contain, as impurities, roots of golden seal, serpentaria, soapwort, wild yam, and stonewort.

Gelsemium, Juss. Yellow Jasmine

Smooth vines with opposite or whorled leaves; flowers in axillary cymes, regular, perfect; calyx deeply 5-parted; corolla funnel-form, 5-lobed; stamens 5, inserted on the tube of the corolla; pistil with a 2-celled ovary; style slender, or filiform, 4-cleft; fruit a capsule, flattened, seeds winged. A small genus of 2 species, one in North America and the second in Asia.

Gelsemium sempervirens (L.) Ait. Yellow Jessamine.

A well known poisonous woody vine climbing over shrubs and trees to the height of thirty feet or more; with opposite or entire ovate or lanceolate leaves, shining and evergreen; flowers showy and fragrant in short axillary clusters, yellow.

Distribution. This plant grows in woods and low grounds from eastern Virginia to Florida, and as far west as Mexico to Guatemala.

Poisonous properties. It contains a poisonous alkaloid, *gelsemin* $C_{24}H_{28}N_2O_4$. The root is frequently used in medicine and poisoning has been caused by overdoses. It is used in febrile and inflammatory infections, and on the nervous system it is an antispasmodic sedative. It is, however, a powerful drug and should be used with great caution. In overdoses it produces nausea, pain in brows and eye-balls, dilation of the pupils, paralysis and dimness of vision. When overdoses have been administered, stomach pump and coffee should be used at once in conjunction with whiskey. *Gelsemin* is a colorless, crystalline, bitter principle. This plant also contains the amorphous, bitter alkaloid, *gelseminin* $C_{22}H_{25}(OH)N_2O_2$.

Dr. Winslow gives the toxicological effects on animals as follows: Muscular weakness, especially in the fore legs, staggering gait and falling. These symptoms are followed by convulsive movements of the head, fore legs, and sometimes of the hind legs. The respiration is slow and feeble, temperature reduced, and there is sweating. Death occurs because of respiratory failure. Morphine subcutaneously has proved a good antidote.

Blyth records that 10 mgrs. killed a frog in 4 hours, 8 mgrs. killed a cat in 15 minutes; 1/6 grain killed a woman in 7½ hours.

Gentianaceae. Gentian Family.

Smooth, bitter herbs with opposite and sessile entire mostly simple leaves without stipules; flowers regular and perfect in clusters or solitary; calyx persistent, 4-12 lobed; corolla gamopetalous, 4-12 lobed or parted, mostly persistent but withered; stamens as many as the lobes of the corolla, alternate, inserted in the throat of the corolla; pistil with a 1-celled or partly 2-celled ovary; ovules numerous, anatropous or amphitropous; fruit a capsule, mostly dehiscent by 2 valves; seeds small, with a minute embryo and fleshy endosperm.

About 600 species of wide distribution. Several plants of the family are used in medicine. The American centaury or rose pink (*Sabatia angularis*) furnishes a simple bitter tonic formerly much used in intermittent fevers. An allied species contains the glucoside *erythrocentaurin*, $C_{27}H_{24}O_8$. The Chirata (*Swertia Chirata*) a bitter tonic, contains the glucoside *chiratin* $C_{26}H_{48}O_{15}$, a very bitter substance, and *ophelic acid* $C_{13}H_{20}O_{10}$. The root of the American columbo (*Frasea carolinensis*) is used as an emetic and cathartic or as a tonic The *F. speciosa* is common in the Rocky Mountains. Several species of the gentian, as *Gentiana Andrewsii, G. puberula,* are used as bitter tonics.

The gentians are largely used in the preparation of the so-called stock foods, the chief constituents of the root being a bitter crystalline glucoside, *gentiopicrin* $C_{28}H_{30}O_{12}$ and *gentisic acid* $C_{14}H_{10}O_5$. The plants act as stomachics and bitter tonics.

Gentians are pretty flowers, but few of them are cultivated. The prettiest of these are the closed gentian (*G. Andrewsii*), with large blue flowers, the white closed gentian (*G. flavida*), the fringed gentian (*G. crinita*), and the Texas lily (*Eustoma Russellianum*), native from Texas to Nebraska and introduced into Colorado, with handsome large blue and white flowers.

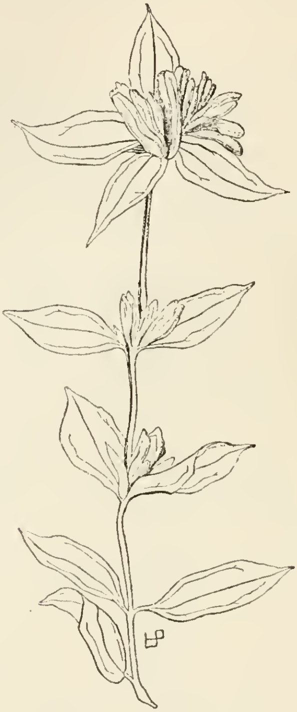

Fig. 396. Yellowish Gentian (*Gentiana flavida*). A plant with bitter properties frequently used in connection with stock foods. (Lois Pammel.)

Menyanthes (Tourn.) L.

Smooth marsh herb with creeping rootstocks; leaves 3-foliolate; flowers conspicuous white or purplish, in racemes or panicle; calyx 5-parted; corolla short, funnel-shaped, 5-cleft; stamens 5, inserted on the tube of the corolla; ovary 1-celled; capsule oval, indehiscent.

Menyanthes trifoliata L. Buckbean. Bog-bean

Perennial from scaly rootstocks; leaves petioled, sheathing at the base; leaflets oblong or obovate; raceme 10-20 flowered; calyx shorter than the white or purplish corolla.

Distribution. Europe and Asia, and North America, especially northward from New England to Greenland and Alaska, Iowa and Minnesota.

Poisonous properties. Buckbean is bitter and suspected of being poisonous. It causes nausea, and contains the substance *menyanthin* $C_{33}H_{50}O_{14}$, in the green parts of the plant.

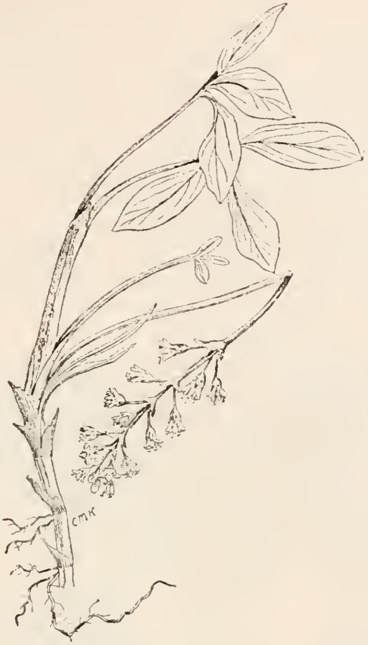

Fig. 397. Buckbean (*Menyanthes trifoliata*). This plant is said to be more or less poisonous. It is very common in low lands. (Charlotte M. King.)

Apocynaceae. Dogbane Family

Perennial herbs; shrubs or vines with acrid or milky juice; entire, mainly opposite leaves; without stipules; and perfect, regular 5-parted flowers; the 5 lobes of the gamopetalous corolla convolute and twisted in the bud; stamens as many as the lobes of the corolla, alternate with them and inserted on the tube, or throat; pollen granular; ovary superior, with 2 distinct ovaries; fruit follicles or drupes; seeds with a large straight embryo, often bearing a tuft of hairs. About 125 genera and 1000 species. Very widely distributed, chiefly in the tropics.

The best known representative, perhaps, under cultivation is the oleander (*Nerium Oleander*) from the Levant, naturalized in Southern Europe, the Southwest and Mexico, and the *Nerium odorum,* of India. The periwinkles, *Vinca minor* and *Vinca major,* are common in cultivation, the most widely distributed being the common periwinkle (*Vinca minor*) erroneously called myrtle, found especially in country gardens and running wild in cemeteries and shady places. Some species of *Gynopogon* have a cumarin-like fragrance. Rubber is obtained from *Ochrosia, Landolphia, Kickxia, Hancornia, Urceola* and others. Of the medicinal species, the *Alstonia*, or Dita Bark, is a handsome forest tree from 50 to 90 feet high; common throughout the Indian Peninsula to Ceylon. The Dita Bark contains the alkaloid *ditamin* $C_{16}H_{19}NO_2$, recommended as a tonic and an antiperiodic; also the alkaloids *echitamin* $C_2H_{28}N_2O_4$ and *echitemin* $C_{20}H_{27}NO_4$. In the bark of *Alstonia spectabilis,* besides *ditamin* and *echitemin* there is found a third alkaloid *alstonamin.* An allied species native of eastern Australia, is used for ague. In North America the dogbanes are also used in medicine. The ordeal tree of Madagascar (*Cerbera Tanghin*) produces a very poisonous narcotic seed. It is used by the natives to poison persons, and formerly criminals were put to death by being pricked with a lance dipped in the juice of the kernel. A single seed is said to contain enough poison to kill 20 people.

Both species of *Apocynum* are used in medicine. The Indian hemp used as an emetic, cathartic and diuretic contains the glucoside *apocynein* and a bitter resin-like extractive, *apocynin,* both of which Schmiedeberg isolated. The *Thevetia neriifolia* of tropical America contains a powerful heart poison, *thevetin* $C_{54}H_{48}O_2$, and *theveresin.* *Strophanthus Kombe* of East Africa is a woody climber, and contains *strophanthin* $C_{16}H_{16}O_8$ which acts like *digitalin,* being valuable in cardiac disease; it is also used as an arrow poison.* The *S. hispidus* contains the same glucoside and an alkaloid *inaein.* The action of this drug is similar to *Digitalis* although not as efficient. The Querbracho (*Aspidosperma Querbracho blanco*) of Argentina furnishes a valuable tanning bark containing 3-4 per cent of tannin; it also contains alkaloids, six of which have been discovered, among them being *aspidiospermin* $C_{22}H_{30}N_2O_2$, *aspidospermatin* and *querbrachin* $C_{21}H_{26}N_2O_2$, *aspidosamin* and *quebrachinamin.* The yellow flowered Nightshade (*Urechitea*) of the West Indies is a cardiac poison not unlike *Digitalis.*

Apocynum. Dogbane

Perennial herbs with opposite entire leaves; small white or pink flowers; calyx 5-parted, with acute lobes and corolla bell-shaped, 5-cleft with 5 small triangular appendages below the throat opposite the lobes; stamens 5, inserted on the base of the corolla, with arrow-shaped anthers; style none; stigma large, ovoid, slightly 2-lobed; fruit of 2 long slender follicles; seeds numerous, small, each with a long silky coma. A small genus of about 15 species, found chiefly in the north temperate zone.

Apocynum androsaemifolium L. Spreading dogbane.

Rootstock horizontal, smooth, or rarely soft-tomentose, branched above,

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*There are also many snake poisons belonging to different families.

In the family *Acanthaceae* are *Andrographis paniculata, Rhinacanthus communis, Barleria cristata* and *B. lupulina,* the latter of which contains not only a large amount of potassium but some alkaloids also.

The common names of a great many plants indicate their supposed virtues as antidotes for snake bites. In the last edition of Gray's Manual, a few of the common names of this class are among the *Compositae*; as Rattlesnake weed (*Hieracium venosum*), Rattlesnake root (*Prenanthes alba, P. serpentaria*), Rattlesnake master or Button snakeroot (*Eryngium yuccifolium*), Black snakeroot (*Sanicula marilandica*); among the *Orchidaceae* Rattlesnake plantain (*Epipactis pubescens*); of the *Gramineae,* Rattlesnake grass (*Glyceria canadensis*), perhaps so named because of the rattling of the spikelets; Snakegrass (*Eragrostis megastachya*), so called because of the odor of the grass; of the *Ophioglossaceae,* Rattlesnake fern (*Botrychium Virginianum*).

spreading; leaves ovate, petioled; cymes loose, spreading, both terminal and axillary; calyx segments shorter than the tubes of the corolla; the latter pale rose color, open, bell-shaped.

Distribution. Common borders of thickets from Canada to British Columbia to Arizona and Georgia.

Apocynum cannabinum L. Indian Hemp

Glabrous or more or less soft-pubescent, 2-3 feet high, smooth, terminated by an erect, close, many-flowered cyme; corolla lobes nearly erect; the tube not longer than the lanceolate segments of the calyx; greenish white; appear in July and August.

Distribution. Common species eastward and troublesome as a weed in northern Mississippi Valley.

Poisonous properties. Said to be poisonous to live stock.

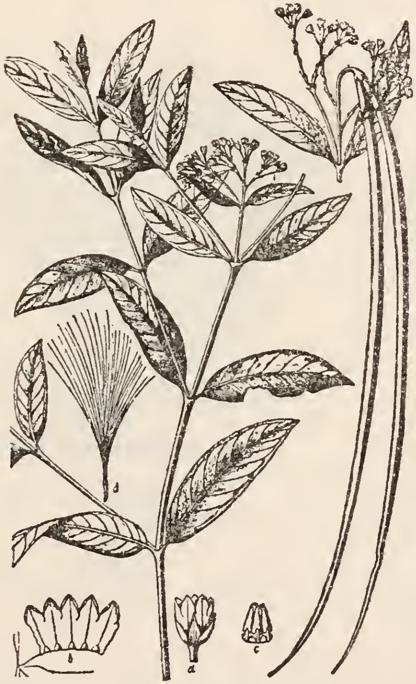

Fig. 398. Indian Hemp (*Apocynum cannabinum*). Flowering and fruiting branches. Bundle of fibers from stem. Section of flower. Furnishes a good bast fiber. (Dodge, U. S. Dept. Agr.)

Nerium. Oleander

Shrubs; leaves coriaceous, rigid, closely and transversely veiny; flowers showy, in terminal cymes; corolla salverform or tube narrow, funnelform; stamens attached to the middle of the tube; style 1; ovaries 2, forming pods; seeds tufted. Native to the Levant and India.

Nerium Oleander L.

Leaves lanceolate; coriaceous, rigid, closely and transversely veiny; flowers in terminal cymes, rose-color or white; anthers scarcely protruding.

Distribution. Native to the Levant, naturalized in Southern Europe, and Southwest United States. Frequently cultivated in greenhouses.

Poisonous properties. John Smith, in his Domestic botany, says, with reference to its poisonous properties:

> It grows abundantly in the valley of the Jordan, and when in flower is very beautiful. The whole of the plant is poisonous, and it is recorded that soldiers in Spain were poisoned through their meat being roasted on spits made of the peeled stem.

Prof. Chesnut states that stock are occasionally poisoned by eating the leaves, as the plant grows wild in northern Mexico and is abundant in the Southwest. The oleander is a heart stimulant acting like digitalis. Dr. S. Wateff recently reported a case in which gastro-enteritis occurred; nausea, vomiting and irritation were prominent symptoms. He also reports the odor of the flower as poisonous.

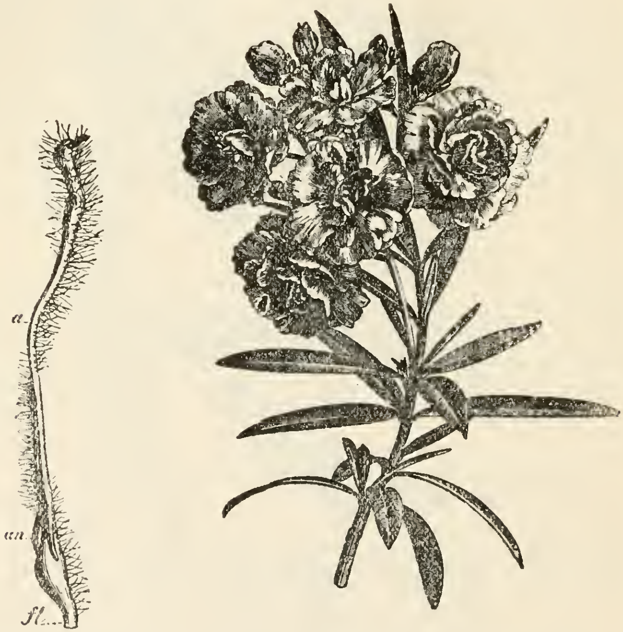

Fig. 399. Oleander (*Nerium Oleander*). At the left, a stamen; *fl.* thread enlarged; *an,* cells of anther; elongated end of connective. At the right, flowering branch. Whole plant poisonous. (From Vesque's Traité de Botanique.)

Prof. F. W. Wilson of the Arizona Station[1] has recently brought together the literature on the subject of oleander poisoning, also giving some of his own experiments.

Prof. Wilson finds that both the pink and white varieties are poisonous. He conducted some experiments with two horses, a cow, a mule, and three sheep:

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[1] *Bull. Ariz. Exp. Sta.* 59:381.

The amount of oleander necessary to cause death in horses ranges from 15 to 20 gm. of green leaves, and from 15 to 30 gm. of dry leaves. This depends on the condition of the animal at the time the poison is obtained. A full stomach will necessitate more poison. In the case of cows it is safe to say that from 10 to 20 gm. of green leaves and 15 to 25 gm. of dry leaves are sufficient to cause death. For sheep the fatal dose of either green or dry leaves is from 1 to 5 gm. There is little danger in the bark, roots, or flowers since live stock would hardly obtain sufficient poison in that way. . .

The general symptoms are increased temperature and pulse, coldness of the extremities, warm body temperature, dilation of the pupils of the eyes, and discoloration of the mouth and nostrils followed by sore mouth. The body becomes wet with sweat, due to the exertion caused by the powerful heart stimulation. The animal generally refuses to eat or drink during the 24 hours preceding death. This is usually due to soreness of the mouth and throat, making it painful to masticate and swallow food. The bowels act often and feces are usually greenish in color. The action of the kidneys is increased slightly and color of urine is normal. There is little doubt that numerous cases of oleander poisoning have never been brought to light because of death being attributed to other sources. It is safe to say, however, that many hundreds of animals have been lost in southern Arizona from this shrub.

ASCLEPIADACEAE. Milkweed Family.

Perennial herbs, vines, or shrubs, with milky juice and opposite or whorled leaves, entire; flowers in umbels, regular; calyx inferior; corolla bell or urn-shaped, rotate or funnel-form, 5-lobed or 5-cleft, the segments generally reflexed; a crown between the corolla and stamens; stamens 5, inserted on the corolla; generally monadelphous; anthers connivent around the stigma or more or less united with each other; commonly bearing an erect or inflexed membrane; pollen collected in masses, generally 10, known as pollinia; ovary consisting of 2 carpels, in fruit of 2 follicles; seeds flattened, usually appendaged by a long tuft of hairs called a coma.

About 200 genera, and 1800 species, of wide distribution, many members of the family being weedy: some are medicinal, but few are economic. Several plants of the family are cultivated. The *Periploca graeca* of the Old World is an ornamental climber and produces granular pollen in place of pollinia. The *Stapelia,* several species of which are cultivated, are natives of the Cape of Good Hope. They produce flowers of dull purple color with transverse stripes, exhaling a very disagreeable odor not unlike that of putrid meat.

The wax plant (*Hoya carnosa*), is a well known house plant of India, with rooting stems; thick, fleshy, oval leaves; and flesh colored flowers. The *Vincetoxicum* is a European climber sometimes cultivated in the Eastern States. Several species native from South America are sometimes cultivated for ornamental purposes. Some species of the order are used in medicine. The Indian sarsaparilla (*Hemidesmus indicus*) growing in the Indian peninsula and Ceylon, has a medicinal root which is used as a tonic and diuretic. The root has the odor of the tonka bean or of sweet clover. The mudar (*Calotropis procera*) also a native of India, from Ceylon and the Moluccas, is common in waste grounds. The bark contains one bitter principle, *mudarin,* used as a tonic and diaphoretic and in large doses as an emetic. It produces a strong fiber, the silk being exported as "kapok," or tree cotton. The Indian ipecacuanha (*Tylophora asthmatica*) is a climbing perennial of India and Mauritius; anciently much used by the Hindoos in dysentery. The pleurisy-root or butterfly-weed (*Asclepias tuberosa*) is used as a diuretic and an emetic. *A. Curassavica* of the West Indes is a vermifuge. The flowers are said to produce excellent honey. Generally, however, honey bees are killed by becoming entangled in the pollen masses of some of the species of *Asclepias.* Many other plants of the order have an acrid poisonous juice. Two of our common species of milkweed (*A. tuberosa*) and (*A. incarnata*) and the (*Vincetoxicum officinale*) contain the bitter glucoside *asclepidin* which is an amorphous, bitter, yellow emetic substance. The root especially, which acts as an emetic, is recorded as poisonous in Europe and cattle and other domestic animals will not eat it. Friedberger and Fröhner state that it causes diabetes and general weakness. The caustic bush *Sarcostemma australe* of Australia is regarded in that country as poisonous. The Condurango (*Marsdenia Cundurango*), a South American vine, is used as an alterative. It is bitter and acrid. The root of *Asclepias stellifera* of South Africa, according to J. Burtt Davy, yields an excellent rubber.

Asclepias (Tourn.) L. Milkweed

Perennial herbs with milky juice, entire leaves; flowers in umbels; calyx 5-parted, persistent, the lobes spreading; corolla deeply 5-parted, reflexed during flowering, deciduous; the crown consists of 5 hooded processes each containing an incurved horn, enclosing the stamen tube; stamens 5, inserted at the base of the corolla; anthers adherent to the stigma, each with 2 cells and containing a pair of pear shaped masses of pollen (pollinia); ovaries 2; follicles 2; the stigma 5-angled or 5-lobed; numerous seeds with a coma. About 85 species, mostly of the new world. Several members of the order are quite weedy, especially in grain fields and pastures.

Asclepias vestita Hook and Arn.

Densely floccose-woolly, the white wool deciduous in age; leaves from ovate to oblong-lanceolate very acute or acuminate, often subcordate, short petioled or the upper sessile, 4-6 inches long; umbels 1-4, the terminal usually peduncled, the lateral all sessile; corolla greenish-white or purplish, the lobes ovate, 3 inches long, column very short; hoods nearly erect, ventricose, slightly surpassing the anthers, entirely at the back of the somewhat truncate summit, auriculate extended at the inner angle, the auricles or angles involute; the crest not horn-shaped attached up to the summit of the hood, blunt not exserted; an interior crown of 10 tooth-like processes in pairs between the hoods; ovaries glabrous; follicles at first canescent.

Distribution. California and adjacent regions.

Poisonous properties. Said to be poisonous. The juice of this species and of *A. eriocarpa* are irritating.

Asclepias mexicana Cav.

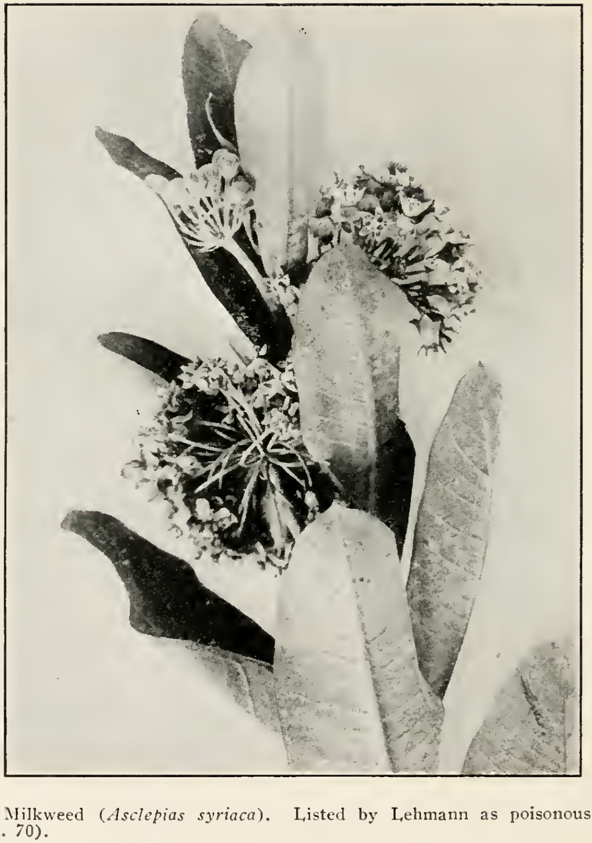
Stem 3-5 feet high; leaves in whorls of 3-6 or uppermost and lower opposite, sometimes also in axillary fascicles, linear or narrowly lanceolate (3-6 inches long, 2-6 lines broad); umbels corymbose, densely many flowered, on peduncles longer than the pedicels; flowers greenish white, sometimes tinged with purple; corrolla lobes oblong; hoods broadly ovate, entire, shorter than the anthers, exceeded by the stout-subulate incurved horn.

Distribution. In the southwest.

Poisonous properties. Said to be poisonous.

Asclepias speciosa Torr. Showy Milkweed

A perennial from 1-4 feet high, white tomentose or canescent; leaves thick, broadly ovate or oval, petioled; pedicel glabrate above; flowers greenish purple,



Common Milkweed (*Asclepias syriaca*). Listed by Lehmann as poisonous. (Bull. Ia. Agr. Exp. Sta. 70).

borne in dense umbels or rarely solitary follicles, erect or spreading on the recurved pedicels.

Distribution. This weed is found in moist soil from Minnesota and northern Iowa to Kansas, in the Rocky Mountain region, common in Colorado, Wyoming and Utah. Troublesome not only in our meadows but occasionally also in our grain fields and gardens.

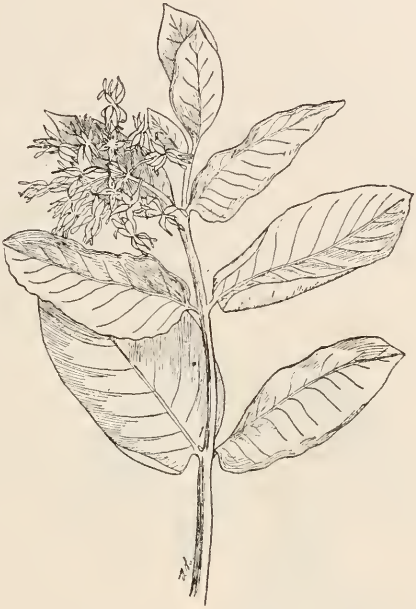


Fig. 400. Showy Milkweed (*Asclepias speciosa*). A well known troublesome weed with milky juice. This plant and other species are known to be poisonous; it is common from Western Missouri and Iowa westward. (Ada Hayden.)

Asclepias syriaca L. Milkweed

A perennial herb with a stout stalk from 2-5 feet high, finely soft, pubescent leaves oval-oblong, or ovate, obtuse or roundish at the base, the young leaf somewhat pubescent above, soon becoming glabrate; petioles stout; flowers borne in umbels, from a few to many, peduncles pubescent or tomentose; corolla dull purple or whitish in color; follicle borne on erect or recurved pedicels.

Distribution. This species is widely distributed in the north, occurring in waste places from New Brunswick to the Saskatchewan, along the Atlantic coast to North Carolina and south and west to Missouri and Kansas.

Poisonous propertics. Said to be poisonous to live stock. It contains *asclepion.* Bees often become entangled in the pollen manes of this and preceding species and are unable to extricate themselves. Lehmann and other European writers list this species as poisonous.

TUBIFLORAE

Mostly herbs, rarely shrubs or trees; corolla generally gamopetalous, irregular or regular; stamens adnate to the corolla tube and generally alternate with them; overy 1-celled, occasionally deeply 4-lobed.

Among the important families of this order are the *Polemoniaceae*, containing the ornamental *Phlox Drummondii*, the perennial *P. maculata*, *P. divaricata*, and *P. pilosa*, many cultivated varieties of *Phlox* and of *Gilia*, of which *G. aggregata* and *Collomia gracilis* are examples. According to Greshoff *Gilia aggregata* contains saponin. It is regarded as a poisonous plant. The order also includes *Pedaliaceae*, including the sesame (*Sesamum indicum*) which furnishes the valuable sesame oil, the plant being indigenous to the East Indies; the *Orobanchaceae* which contains the troublesome broom rapes, (*O. ramosa* and *O. minor*); the *Gesneriaceae* containing the *Gloxinias*, native to Mexico but cultivated in this country as greenhouse plants; the *Lentibulariaceae* which includes the bladderwort (*Utricularia vulgaris*) and other insectivorous plants which are sometimes destructive to fish, and the butterwort (*Pinguicula vulgaris*) found in northern regions, the leaves of which are used by the Lapps to curdle reindeer's milk and also to thicken fresh warm milk so that it will neither curdle nor form cream afterward but makes a palatable tenacious mass, a small portion of which will act similarly upon another quantity of fresh milk; and the *Acanthaceae* containing several plants cultivated as ornamentals like the *Thunbergia alata* and the *Ruellias*. The *Ruellia ciliosa* is used as a substitute for *Spigelia* and is common in the central states to Iowa and Southward. The *Barleria Prionitis* of Siam is used for snake bites. The *Strobilanthes callosus*, a shrub found in India, is an irritant poison, according to Major Kirtikar, these irritant properties being due to hairs on the leaves.

FAMILIES OF TUBIFLORAE

Corolla generally regular.
    Ovary not 4 lobed, ovules 2 or more.
        Style 1, ovary 2-celled; fruit a berry or capsule............Solanaceae.
        Style 1, entire 2-cleft or 2-parted; frequently twining plants.. Convolvulaceae.
        Style 1, 2-lobed or 2-parted; herbs not twining......Hydrophyllaceae.
    Ovary generally 4-lobed..Boraginaceae
Corolla generally irregular.
    Ovary generally 4-lobed..Labiatae.
    Ovary not 4-lobed.
        Placentae axillary..................................Scrophulariaceae.
        Placentae parietal ....Bignoniaceae.

CONVOLVULACEAE

Chiefly twining or trailing herbs, shrubs or trees, some with milky juice; alternate leaves without stipules; flowers regular and perfect; calyx inferior, 5-parted or 5-divided; a 5-lobed or plaited corolla, convolute or twisted in the bud; stamens 5, inserted on the tube of the corolla and alternate with its lobes; a 2-celled, rarely 3-celled ovary with a pair of erect ovules in each cell. About 900 species of wide distribution, but chiefly in warm regions. Contains a number of important economic plants, among them the sweet potato (*Ipomoea*

Batatas), which has been widely cultivated in all tropical and sub-tropical countries and is a well known and cultivated plant in the United States. There are many varieties. In the South the large varieties are called yams, but these should not be confused with the Chinese yam (*Dioscorea*), which forms an important article of food in tropical countries, in the islands of the Pacific and in New Zealand. The man of the earth (*Ipomoea fastigiata*) was used by the Indians as food. It has properties similar to Jalap, for which it is sometimes substituted. The *Ipomoea Jalapa*, native to Mexico, produces a large root which is also a purgative and contains a glucoside *convolvulin* $C_{31}H_{50}O_{16}$. Several plants of the order, like the moon-flower (*Ipomoea Bona-nox*), the morning-glory (*Ipomoea purpurea*) and cypress vine (*Ipomoea Quamoclit*) are cultivated for ornamental purposes. Several, like Jalap (*Ipomoea Purga*) and (*I. congesta*) are used in medicine and are strong purgatives. The scammony (*Convolvulus Scammonia*) of Western Asia is also used as a purgative, the milky juice being collected when hard, it contains *scammonin* $C_{34}H_{56}O_{16}$. *Convolvulus scoparius* and *C. floridus,* furnishing the oil of rhodium, are small shrubby species of the Canary Islands. The wood is strongly scented and the oil is used to adulterate attar of roses.

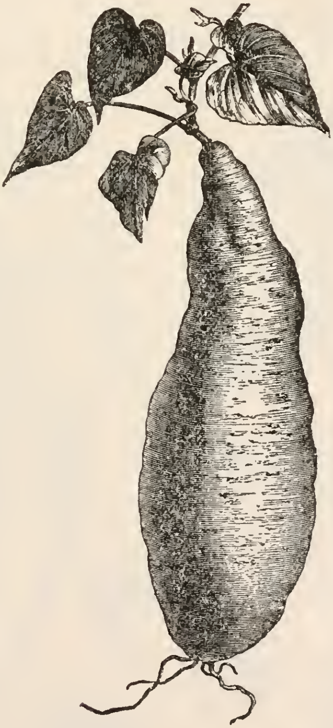


Fig. 401. Sweet Potato (*Ipomoea Batatas*). A well known cultivated plant in tropical and sub-tropical countries. (From Vesque's Traité de Botanique.)

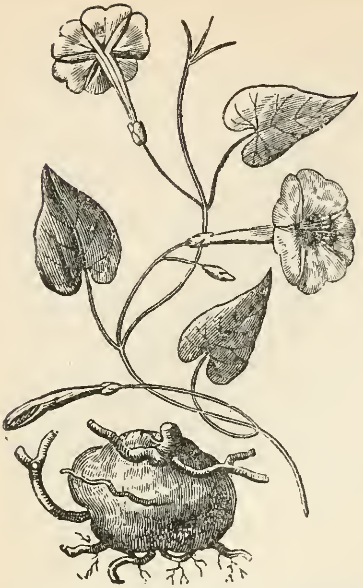


Fig. 402. Jalap (*Ipomoea Purga*). Plant and tuber. Furnishes a strong purgative. (From Vesque's Traité de Botanique.)

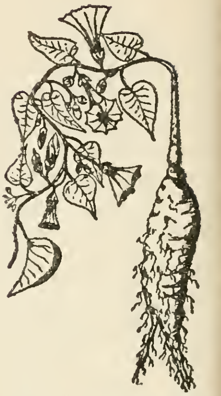


Fig. 403. Man-of-the-Earth (*Ipomoea fastigiata*.) Used by the Indians as food. (Millspaugh Selby.)

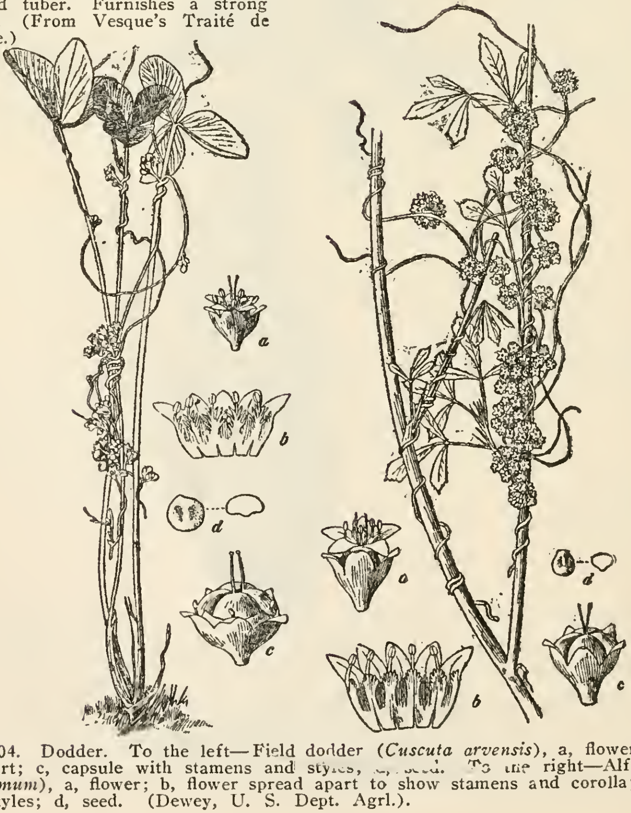


Fig. 404. Dodder. To the left—Field dodder (*Cuscuta arvensis*), a, flower; b, flower spread apart; c, capsule with stamens and styles, d, seed. To the right—Alfalfa dodder (*C. epithymum*), a, flower; b, flower spread apart to show stamens and corolla; c, capsule showing styles; d, seed. (Dewey, U. S. Dept. Agrl.).

The dodders (Cuscuta) belong to the family *Cuscutaceae*, and are of interest in this connection mainly because they are parasitic on clover, alfalfa and other plants. Those growing on the above named plants are *Cuscuta arvensis* and *C. Epithymum*; the flax dodder (*C. Epilinum*) occurs on flax. The plants contain *cuscutin*. From two independent sources in this country there have come reports that clover dodder is injurious. Dr. J. L. Taylor of Lisbon, Ohio, wrote Prof. A. D. Selby that when dodder was fed to horses it caused bowel trouble. Dr. E. H. Jenkins of Connecticut states that cattle were seriously troubled with scours when clover hay in which this plant occurred was a part of the ration. He could not determine whether it was the dodder or the mould which had developed because the dodder had so matted with the clover the hay was not cured well. When this hay was cut out from the ration the trouble ceased.

Ipomoea L. Morning Glory

Twining or erect herbs; flowers large, showy, axillary; calyx 5-parted; corolla broadly bell-shaped, 5-cleft; stamens included; pistil with 2-4 celled ovary, 4-6 ovules; style undivided; stigmas capitate, 1, 2 or 3; fruit a globular capsule, 4-6 seeded. About 350 species, tropical, or of warm regions.

The *Ipomoea leptophylla* of the plains of Nebraska to Kansas and the Rocky Mountains produces a large root weighing from 10-100 pounds; it has an erect non-twining stem from 2-4 feet high; narrow and long leaves; large pink purple flowers.

Ipomoea fastigiata Sweet. Man of the Earth. Wild Potato

A deep rooted, smooth, trailing or twining perennial with a stout, large root occasionally weighing 30 pounds; leaves heart-shaped, acuminate or occasionally fiddle-shaped; peduncles 1-5-flowered; sepals smooth, ovate, oblong, very obtuse; corolla funnel-shaped, 3 inches long, tube purplish; pistil with a 2-celled ovary; stigma 2-lobed; each cell 2-seeded.

Distribution. Common in fields, dry or alluvial grounds from New England to Florida to Ohio, Michigan, Illinois, to Texas.

Poisonous properties. The large root of this plant is said to be poisonous; it contains the glucoside *ipomoein* and is purgative. The same is true of *I. leptophylla*. The *I. Purga* is regarded as somewhat poisonous.

Convolvulus (Tourn.) L. Morning Glory or Bindweed

Herbs or somewhat shrubby plants; twining, erect or prostrate; leaves generally cordate or sagittate and petioled; flowers large and axillary; calyx bractless or with a pair of bracts; sepals nearly equal; corolla funnel-form or campanulate; stamens included, inserted on the tube; style undivided or 2-cleft at the apex; stigmas 2, filiform, oblong or ovoid; ovary 1 or 2 celled with 4 ovules; fruit a capsule, 1-4 celled, 2-4 valved. About 175 species of wide distribution.

Convolvulus sepium L. Hedge Bindweed

Smooth, occasionally pubescent, twining around supports or trailing; leaves triangular, halberd or arrow-shaped, the tip acute or pointed, the basal lobes obliquely truncate or sinuate lobed; the flowering peduncles 4-angled, with 2 leaf-like bracts which are commonly acute; corolla is white or tinged with rose purple.

Distribution. The weed is common in the Mississippi Valley in the moist alluvial bottoms along streams and in fields. It is also found extensively creeping over weeds and other herbaceous vegetation and roadsides throughout the state. The species is native to North America and is common from Nova Scotia to Maine, south to North Carolina and Texas to Kansas, Utah, Montana, Minnesota and eastward. It also occurs in Europe and Asia.

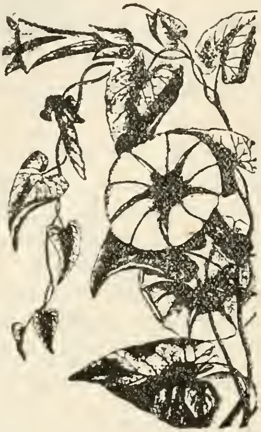


Fig. 405. Bindweed (*Convolvulus sepium.*) Supposed to be poisonous to swine. (After Vasey.)

Poisonous properties. The plant has a somewhat disagreeable odor. Dr. Schaffner states that it is supposedly poisonous to swine. It is more than likely that some of the same substances are found in hedge bindweed that occur in Jalap. Jalap contains the glucosides *convolvulin* $C_{31}H_{50}O_{16}$, *jalapin* $C_{34}H_{56}O_{16}$, *turpethin* $C_{34}H_{56}O_{16}$, *tampicin* $C_{34}H_{54}O_{14}$. The rootstock is rich in starch.

Convolvulus arvensis L. European Bindweed

A deep-rooting perennial; procumbent stem, twining or creeping; propagates freely by underground rootstocks; the leaves from 1 to 2 inches long, ovate, oblong, arrow-shaped, the lobes at the base running to a point; the flowers are borne in 1-flowered peduncles with very small leaf-like bracts some distance from the flowers; flowers an inch or less long, short; broadly funnel-shaped, white, or commonly of a rose tinge.

Distribution. This weed has been known for a considerable length of time in eastern North America, where it has been sparingly naturalized for some time. Its distribution may be given as Nova Scotia to Ontario, New Jersey, Nebraska and Kansas.

Poisonous properties. Probably the same as the preceding. European authorities list this and the common morning glory, especially the latter, as somewhat poisonous because of their purgative properties.

HYDROPHYLLACEAE. Water-leaf Family

Herbs, generally hairy; with alternate leaves; perfect, regular 5-parted flowers; calyx inferior, deeply cleft or divided; corolla gamopetalous; stamens 5, inserted on the corolla; ovary superior, 2-celled, with 2 parietal placenta; styles 2-cleft or partially united; fruit a capsule, seeds generally reticulated or pitted.

A small family of 17 genera and about 160 species, chiefly in western North America. Very few plants of the family are ornamental. Some of the western species are occasionally cultivated. Of these the *Phacelia* is the most important. A few of the plants are weedy. The Yerba Santa (*Eriodictyon crassifolium*) is an evergreen shrub with funnel-shaped, white or purple flowers in cymose clusters; it contains a yellow acrid resin, a crystallin principle, *eriodictyonic acid* and *eriocolin.*

Phacelia Juss.

Mostly hirsute, hispid, or scabrous herbs; leaves alternate or the lower opposite; flowers blue or purple, violet, or white; inflorescence hispid; calyx naked at the cymes; deeply 5-parted; stamens attached near the base of the corolla; ovary 1-celled; capsule 1-celled or falsely 2-celled; seeds reticulated. About 80 species, natives of the New World.

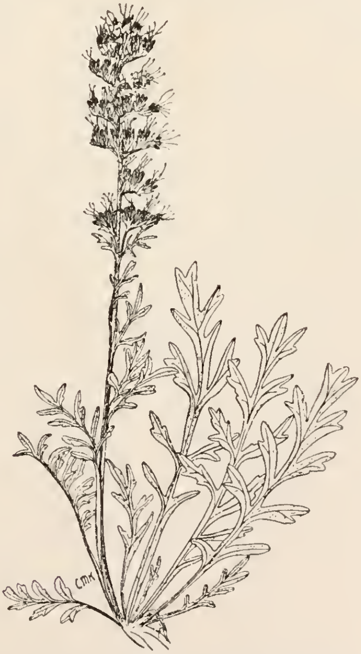


Fig. 406. Hairy Phacelia (*Phacelia sericea*). The Phacelia is common in the Rocky Mountains. The bristly hairs produce mechanical injuries. (Charlotte M. King.)

Phacelia sericea A Gray

Herbs 6 inches to a foot high from a branching caudex, silky-pubescent or canescent, or the simple virgate stems and inflorescence villous-hirsute, rather leafy to the top; leaves pinnately parted into linear or narrow-oblong numerous and often again few-cleft or pinnatifid divisions, silky canescent or sometimes greenish; the lower petioled; the uppermost simpler and nearly sessile; short spikes crowded in a naked spike-like thyrsus; corolla violet-blue or whitish; stamens long exserted; capsule a little longer than the calyx.

Distribution. Common in the mountains from Colorado and northward in rather dry soil.

Phacelia Menziesii Torr.

Herbs 6 inches to a foot high, at length paniculate-branched, hispid or roughish-hirsute; leaves mostly sessile, linear or lanceolate and entire, or some of them deeply cleft; the lobes few or single, linear or lanceolate, entire; spikes or spike-like racemes thyrsoid-paniculate, at length elongated and erect; corolla bright violet or sometimes white; stamens about the length of the corolla; capsule shorter than the calyx.

Distribution. Common in the Rocky Mountains from Montana to Utah and westward.

Poisonous properties. The stiff bristles upon these plants certainly produce mechanical injuries. A form of dermatitis venenata occurs after handling the plants. The writer has had abundant experience in contact with these plants in the Rocky Mountains.

BORAGINACEAE. Borage Family

Herbs, shrubs or trees, with alternate entire, rough or frequently scabrous or setose leaves; flowers perfect, usually regular, generally blue, borne in one-sided spikes; racemes, cymes or scattered; calyx inferior, mostly 5-lobed or 5-cleft; corolla short, bell or wheel-shaped 5-cleft or 5-parted; stamens as many as the lobes of the corolla and alternate with them; ovary superior, deeply 2-lobed; style entire; capsule globular; fruit forming 4 seed-like, 1-seeded nutlets, or into two 2-seeded or four 1-seeded nutlets.

A large family of wide distribution, consisting of about 80 genera and 1500 species. Some of the members are ornamental and are frequently cultivated, like the common heliotrope (*Heliotropium peruvianum*), native to Peru, used for bedding and in greenhouses. Borago or borage (*Borago officinalis*), used in old gardens for ornamental purposes is an excellent honey plant. Lungwort (*Mertensia virginica*), an early spring blooming plant of the North, with handsome blue flowers, is occasionally cultivated. The Rocky Mountain *M. sibirica* is an equally handsome species. The forget-me-not (*Myosotis scorpioides*), with small but pretty blue flowers, native of Europe, is occasionally cultivated. Alkanet (*Alkana tinctoria—Anchusa tinctoria*), a native of southern Europe, yields a red dye used for coloring oils and wax. Other plants of this order yield a similar product and one species is known to color the wool of sheep. The roots of the common puccoon (*Lithospermum*), also yield a dye. The comfrey (*Symphytum officinale*) is used as a forage plant in Europe, but in the United States is seldom cultivated. The wood of *Cordia alba* is used by military authorities in San Juan in the manufacture of gun carriages, carpenters' benches, vises, etc.

Genera of *Boraginaceae*

Ovary not lobed....................Heliotropium
Ovary deeply 4-lobed.
  Flowers regular.
    Nutlets horizontally radiate, covered with prickles........Cynoglossum
    Nutlets erect, armed with prickles....................Lappula
  Corolla irregular.
      Stamens exserted ....Echium

Heliotropium (Tourn.) L. Heliotrope

Herbs or shrubs with entire alternate leaves; the small blue or white flowers, scattered or borne in scorpoid spikes; corolla salver or funnelform without appendages, more or less plaited in the bud; stamens not exserted, with nearly sessile anthers; stigmas conical or capitate; fruit 2-4-lobed, separating into 4, 1-seeded nutlets or into 2, 2-seeded carpels.

About 115 species, mostly tropical. The best known representative in the North is the cultivated *H. peruvianum.* The seaside heliotrope (*H. curassavicum*) occurs in saline soil along the Atlantic coast, to Maine, and from Mexico to Illinois and westward.

Heliotropium indicum L. Indian Heliotrope

An erect, hairy annual with hirsute or hispid stem; leaves petioled, ovate or oval and somewhat heart-shaped; flowers blue, borne in spikes; fruit deeply 2-lobed, smooth, 2 seeds in each cell.

Distribution. Common in waste places from North Carolina to Southern Indiana and Missouri. Naturalized from India.

Heliotropium europacum L. European Heliotrope

An erect annual, branched, roughish pubescent herbs; leaves oval, long petioled, narrow at the base; flowers borne in 1-sided bractless spikes, the terminal spikes in pairs; calyx spreading, the segments shorter than the corolla tube; anthers distinct, obtuse.

Distribution. Common in waste places southward. New York to Pennsylvania and Florida.

Poisonous properties. The European heliotrope contains *heliotropin,* a bitter, volatile, alkaline, poisonous alkaloid.

Cynoglossum (Tourn.) L. Hound's Tongue

Hirsute or hispid, rarely smooth herbs; alternate or entire leaves; purple, blue or white flowers in panicled racemes; calyx 5-cleft or 5-parted; corolla funnelform or salverform, the throat clothed with 5 obtuse scales; ovary deeply 4-lobed fixed near the apex to the base of the style, roughened with short barbed or hooked prickles. About 75 species, of wide distribution.

Cynoglossum officinale L. Hound's Tongue

A coarse biennial herb, clothed with short, soft hairs; lower leaves oblong or oblong lanceolate, the upper closely sessile with a slightly heart-shaped base; racemes nearly bractless, elongated in fruit; divisions of the calyx ovate, lanceolate, acute; corolla reddish-purple, rarely white; nutlets flat on the broad upper face, splitting away at maturity.

Distribution. In fields and waste places, especially eastward from New England to Quebec, Ontario, Minnesota, Manitoba, and Kansas.

Cynoglossum virginianum L. Wild Comfrey

Perennial hirsute herb with simple stem, 2-3 feet high, leafless above; stem leaves lanceolate oblong, clasping by a heart-shaped base; flowers long-peduncled, pale blue, small; fruit broad, nutlets not margined, convex on the upper surface.

Distribution. Common in woods of the central Mississippi Valley states from New Brunswick to Ontario, Florida, Louisiana to Texas.

Poisonous properties. The common hound's tongue is suspected of being poisonous. The European species, *C. officinale,* contains a powerful alkaloid, *cynoglossin,* which resembles curare in its action. It also has the principle *consolidin.*

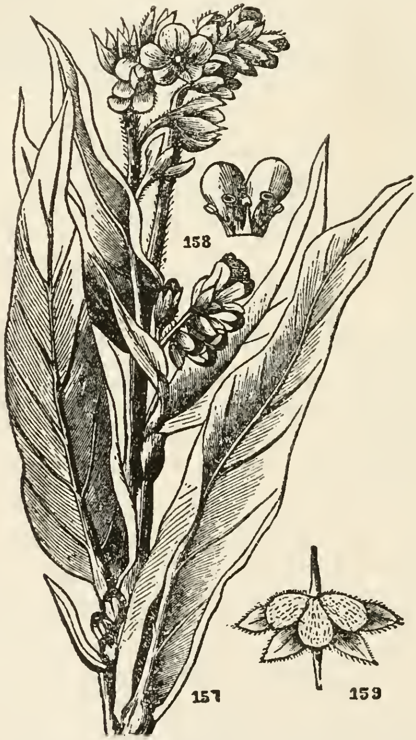


Fig. 407. Hounds-tongue (*Cynoglossum officinale*). Suspected of being poisonous. (From Darlington's Weeds and Useful Plants.)

Lappula (Rivinus) Moench. Stickseed

Roughish pubescent or hairy herbs with alternate narrow or entire leaves, small blue or white flowers in racemes or spikes; calyx deeply 5-cleft or 5-parted with narrow segments; corolla salverform or funnelform.

About 40 species in north temperate regions, several of which are weedy in North America.

Lappula virginiana (L.) Greene. Beggar's Lice

A coarse pubescent biennial from 2-4 feet high; lower leaves ovate, orbicular cordate, long, petioled; stem leaves ovate-oblong or oval; flowers nearly white; globose nutlets, flattened and barbed.

Distribution. Common especially in woods northward from New Brunswick to Wisconsin, Minnesota, Kansas to Louisiana.

Lappula echinata Gilbert. Stickseed

An erect annual from 1-2 feet high; pale, leafy, hispid with erect branches; leaves linear or linear-oblong; racemes 1-sided, bracteolate; calyx segments lanceolate; corolla blue; nutlets rough-granulate or tuberculate on the back, the margins with a double row of slender prickles.

Distribution. Abundant in waste places along roadsides from eastern Canada and New England to Minnesota, Kansas and British Columbia. Weedy also in Europe, where it is native.

Lappula floribunda (Lehm.) Greene. Large-flowered Stickweed

An erect perennial or biennial, rough-pubescent; 2 feet or more high; leaves oblong to linear-lanceolate, the lower tapering on margined petioles; racemes erect or nearly so; pedicels deflexed in fruit; flowers pretty; blue, occasionally white; nutlets scabrous on the margin with a row of flat prickles.

Distribution. Common in Saskatchewan and Minnesota and abundant in the Rocky Mountains.

Poisonous properties. perhaps the fruits of all the species are somewhat injurious to animals, causing inflammation. They are frequently found in wool.

Echium L. Blueweed

Bristly annual, biennial, or perennial; erect stems; corolla with a funnelform tube and a 5-lobed spreading border; stamens many, exserted. The 30 species are natives of the old world.

Echium vulgare (Tourn.) L. Blueweed

An erect, rough, bristly biennial, 18 inches to 2 feet high, with an erect, mostly simple stem; leaves of the stem linear-lanceolate, sessile; flowers in cymose clusters; corolla reddish-purple, changing to blue; tube funnelform, border unequal, spreading, 5-lobed; stamens 5, inserted on the tube; style threadlike; nutlets roughened or wrinkled.

Distribution. A common weed along roadsides, fields, and meadows from New England to Indiana.

Poisonous properties. Probably poisonous. According to Friedberger and Fröhner it causes slavering.

VERBENACEAE. Verbena Family

Herbs, shrubs or trees, with opposite or alternate leaves; perfect, regular, or somewhat irregular flowers borne in spikes, racemes, cymes or panicles; calyx generally persistent, inferior, 4-5-lobed or cleft; corolla 4-5-cleft, tube cylindrical; stamens 4, didynamous or 2; ovary superior, 2-4-celled or more; fruit dry or drupaceous, splitting into 1-4 nutlets.

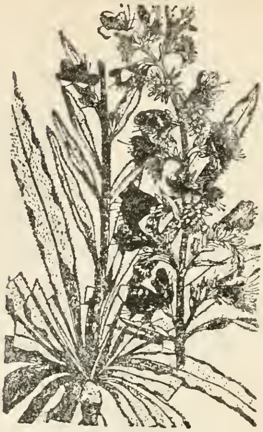


Fig. 408. Blueweed (*Echium vulgare*). Probably poisonous. (Vasey-Selby).

A large family which is found chiefly in tropical regions, there being about 1200 species. The wood of some of the tropical members of the family is valuable. Among these is the Indian teak tree, (*Tectona grandis*), native to India. The wood is hard, heavy and very durable and is used in ship-building and for railway cars. The *Vitex littoralis,* a large tree, native of New Zealand, produces a hard and heavy wood. The fragrant leaves of *V. Negundo* are used to stuff pillows.

This family includes many ornamental plants, the most commonly cultivated in green houses being the *Clerodendron Thompsonae,* which has a showy crimson corolla and white calyx. The lemon verbena, (*Lippia citriodora*), a stiff, branching shrub from Chili, is commonly cultivated in the south on account of its very fragrant leaves; an oil, from it, contains *citral.* The fog-fruit, (*L. nodiflora*), is valued in Egypt as a lawn plant, proving a success where all grasses or other plants tried for that purpose have failed, the lawns lasting five or six years without renewal. The *Lippia mexicana,* used in medicine, contains *lippiol.* The extensively cultivated verbena of our flower gardens is the *V. Aubletia,* which is produced in many colors, the species being native from southern Indiana to Texas. Lantanas are also cultivated. The French mulberry, (*Callicarpa americana*), is said to be poisonous. The vervains (*Verbena stricta* and *V. hastata*) with blue flowers, are common pasture weeds. The white vervain (*V. urticaefolia*) contains a bitter glucoside.

LABIATAE. Mint Family

Chiefly aromatic herbs, some shrubs and trees; with square stems; opposite leaves without stipules; flowers with cymose inflorescence, perfect, irregular, more or less 2-lipped; calyx 5-toothed or 5-lobed; corolla 4-5-lobed, commonly 2-lipped, upper 2-lobed or entire, the lower usually 3-lobed, stamens borne on the corolla tube; ovary superior, deeply 4-lobed or 4-parted, in fruit forming 4 small seed-like nutlets or achenes surrounded by the persistent calyx; usually exalbuminous or with some albumin. A large family of about 3000 species of very wide distribution. Many of these plants are used in medicine. Lavender (*Lavandula vera*) of the mountain regions of northern and eastern Europe, is cultivated for the oil of lavender, much used in perfume and contains *linalool* and *geraniol.* Spearmint (*Mentha spicata*) a fragrant perennial plant of Europe is used by confectioners and in the manufacture of perfumed soap. The volatile oil contains *carvol* $C_{10}H_{14}O$. Peppermint (*Mentha piperita*) a native to Europe and naturalized in North America, is cultivated in New York and Michigan for the manufacture of peppermint oil. It contains a volatile oil and *menthol* $C_{10}H_{20}O$, and is used for flavoring mutton and sweetmeats and as a cordial. It is a stimulant. The Japanese peppermint is obtained from *M. arvensis* var. *piperascens.* Pennyroyal (*Mentha Pulegium*), native to Europe, is used for the same purposes for which peppermint is used. Garden thyme (*Thymus vulgaris*) is a small erect woody shrub of southern Europe; it is fragrant, has a pungent taste and contains *thymol* $C_{10}H_{13}ON$, which is used as an antiseptic. It also contains *cymene, borneol,* and *linalool.* Rosemary (*Rosmarinus officinalis*), an evergreen shrub of Europe, is chiefly used as a perfume. This and *Lavandula Spica* both contain *borneol* $C_{10}H_{18}O$, one of the pinene group of terpenes and *camphene.* Germander (*Teucrium canadense*) is a stimulant and has aromatic properties. Horse mint (*Monarda fistulosa*) is a stimulant and is used to remove colic pain. Oswego tea (*Monarda didyma*) is used as a substitute for tea, and catnip is used for the same purpose. *M. punctata* contains *thymol, carvacrol,* etc. Horehound (*Marrubium vulgare*), a perennial weed native to Europe, is a stimulant and tonic and is also slightly laxative. It contains the bitter principle *marrubin.* Sweet basil (*Ocimum Basilicum*) of India is a strong aromatic herb used for culinary purposes and in the manufacture of Chartreuse liquors while the mucilaginous

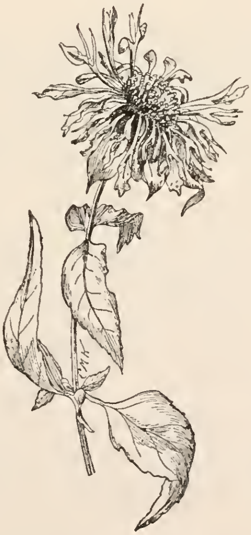


Fig. 409. Horse Mint (*Monarda fistulosa*). A common roadside weed with pungent properties. (Charlotte M. King).

"seeds" are used for genito-urinary troubles. Savory (*Satureia hortensis*) an annual herb of Europe, sparingly run wild in western United States, is used as a pot herb. The patchouli (*Pogostemon Heyneanus*) is used by the Arabs to scent mattresses and shawls. Sage (*Salvia officinalis*) is cultivated as a pot herb and contains *pinene, cineol, thujone* and *borneol.* Marjoram (*Origanum majorana*), a perennial plant native to South of Europe, and cultivated as an aromatic herb, is also an excellent honey plant containing *citral.* Many species of mints, like the brilliantly colored South American sage (*Salvia coccinea, S. splendens,* etc.) and others native to the southern states and the west, are cultivated for ornamental purposes. The lance leaved sage (*S. lanceolata*) is a troublesome weed in the West. *S. officinalis* of Europe, a stimulant and tonic, contains *cineol* and *salviol* $C_{10}H_{18}O$, and is commonly used with meat and sausage in German communities. The Japanese potato (*Stachys Sieboldii*), is used as the Jerusalem artichoke is. Sweet balm (*Melissa officinalis*), a pot herb, contains a bitter principle.

Cymol, $C_{10}H_{14}O$, one of the *benzol* derivatives, occurs in many of the Labiates, especially in *Thymus officinalis, Monarda punctata,* and *Micromeria punctata. Thymol,* a *benzol* derivative, is also found in *Origanum floribundum* and *Monarda citriodora.*

Genera of *Labiatae*

Calyx rigid, spiny, pointed....................3 Leonurus
Calyx not spiny toothed.
  Anthers approximate.
Fertile stamens 2....................2 Hedeoma
Fertile stamens 4....................
  Calyx tubular curved....................1 Nepeta
  Calyx bell-shaped,
    Aromatic herbs, stamens exserted....................5 Mentha
    Not aromatic herbs ascending under the upper lip..........4 Lamium

1. *Nepeta* L. Catnip

Herbs with dentate or incised leaves; flowers white or blue, in clusters; calyx tubular; corolla 2-lipped, lower lip spreading, 3-lobed. About 150 species native to Europe and Asia.

Nepeta Cataria L. Catnip

A perennial erect herb, 1-3 feet high; leaves ovate, cordate, coarsely serrate, petiolate, whitish, downy underneath; flowers in cymose clusters; corolla whitish, dotted with purple.

Distribution. Native to Europe; widely naturalized in northern states.

Nepeta hederacea (L.). Trevisan. Ground Ivy

A creeping, trailing perennial, with leaves all alike; petioled, round, kidney-shaped, crenate, smooth green on both sides; flowers light blue in axillary whorls of about 6, appearing in early spring and summer.

Distribution. Native to Europe, widely naturalized in the northern states, especially in shady places.

Poisonous properties. According to Dr. Schaffner, Ground Ivy is said to be poisonous to horses. Contains a volatile oil and a bitter principle. The common catnip also contains a volatile oil and bitter principle.

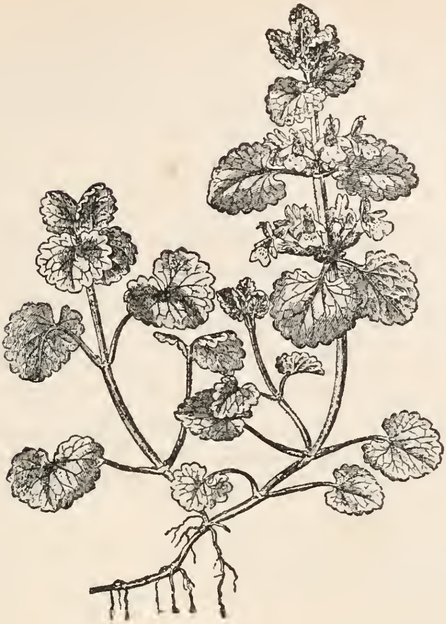


Fig. 410. Ground Ivy (*Nepeta hederacea*). A somewhat weedy plant, naturalized from Europe. Said to be poisonous to horses. (From Johnson's Med. Bot. of N. A.).

2. *Hedeoma* Pers.

Aromatic, pungent herbs; leaves small; flowers in axillary clusters, crowded into terminal spikes or racemes; calyx ovoid or tubular, bearded in the throat, 2-lipped; the upper lip toothed; corolla 2-lipped, the upper 2-lobed, the lower spreading, 3-cleft; fertile stamens, 2; the upper pair reduced to sterile filaments or wanting; nutlets ovoid, smooth.

Hedeoma pulegioides Pers. American Pennyroyal

An erect, branching, hairy annual; leaves ovate to ovate-oblong, petioled, sparingly serrate; whorls few flowered; upper calyx teeth triangular, gibbous; corolla bluish; rudimentary stamens, evident but not usually anther-bearing.

Poisonous properties. It has been regarded with suspicion. It has the odor and taste of true Pennyroyal. *Hedeoma pulegioides* contains a volatile oil, *hedeomol* $C_{10}H_{18}O$.

Leonurus L. Motherwort

Tall herbs with palmately cleft or dentate leaves; flowers small, white or blue, in axillary clusters; calyx tubular, 5-nerved and 5 rigid teeth; corolla 2-lipped. About 10 species in the old world.

Leonurus Cardiaca L. Motherwort

Tall perennial herb with erect stem, 2-6 feet high; leaves long petioled, the lower round and palmately lobed, the upper crenate at the base, 3-cleft; flowers pale purple in close axillary whorls; corolla bearded.

Distribution. Native to Europe, widely naturalized in the northern states.

Injurious properties. The stiff bristles of the calyx are often injurious, producing mechanical injuries. It contains a volatile oil with an unpleasant odor, a bitter principle, etc.

Lamium L. Dead Nettle

Decumbent herbs; leaves usually cordate, doubly toothed; flowers small, axillary and terminal clusters; calyx tubular; 5-toothed, the teeth nearly equal, the upper ones larger; corolla dilated at the throat, upper lip ovate or oblong arched, narrowed at the base, the middle lower lip spreading, the lobe notched at the apex; stamens 4, small; the anthers nearly in pairs, nutlets truncate. About 40 species in the old world; some troublesome weeds like *L amplexicaule.*

Lamium amplexicaule L. Dead Nettle

An annual or biennial herb with rounded, deeply toothed, crenate leaves; the upper leaves small, clasping; calyx tubular, 5-toothed; flowers small; corolla purple, upper lip bearded, the lower spotted. The *L. album* is perennial, has larger flowers, and has slender calyx teeth.

Distribution. Common in the eastern states to Missouri. The *L. album* escaped and not infrequent westward.

Injurious properties. The dead nettle is regarded as injurious.

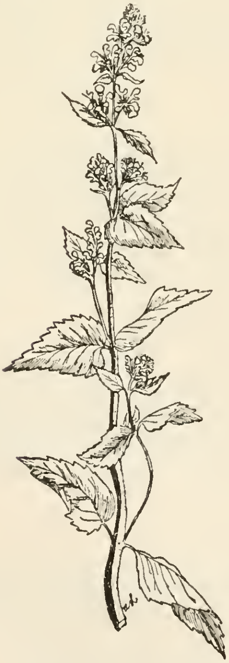


Fig. 411. Dead Nettle (*Lamium, album*), frequently escaped from cultivation. (Ada Hayden).

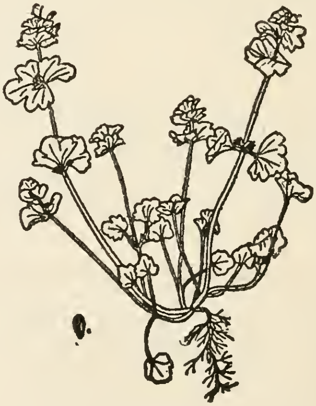


Fig. 412. Dead Nettle (*Lamium amplexicaule*). Regarded as poisonous. (Selby).

Mentha (Tourn.) L. Mint

Herbs with the odor of mint. Leaves usually with punctate spots; flowers small in whorled clusters, pink or white; calyx bell-shaped or tubular, 5-toothed; corolla tube shorter than the calyx; limb 4-cleft; stamens equal, erect, included or exserted; filaments smooth; nutlets ovoid, smooth. About 30 species of temperate regions. Our native species (*M. arvensis,* var. *canadensis*) is common in low marshy ground.

Mentha crispa contains *linacol,* $C_{10}H_{18}O$, one of the terpenes. It may be mentioned in passing that this same substance recurs in *Ocimum Thymus* and *Darwinia.* A ketone-carbon, $C_{10}H_{14}O$, is found in several species of the genus.

Mentha piperita L. Peppermint

Smooth, erect, perennial herb with creeping rootstocks from 1-2 feet high; leaves petioled, ovate, oblong to oblong-lanceolate, acute and sharply serrate; flowers whorled in interrupted loose, leafless spikes; purplish or whitish.

Distribution. Commonly escaped from cultivation and troublesome in the East.

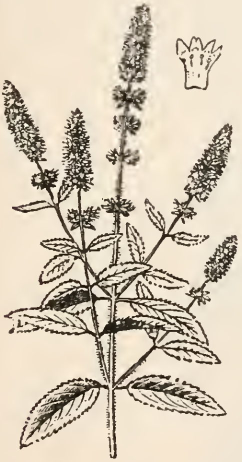


Fig. 413. Peppermint (*Mentha piperita*). One of the sources of the peppermint of commerce. (From Vesque's Traité de Botanique).

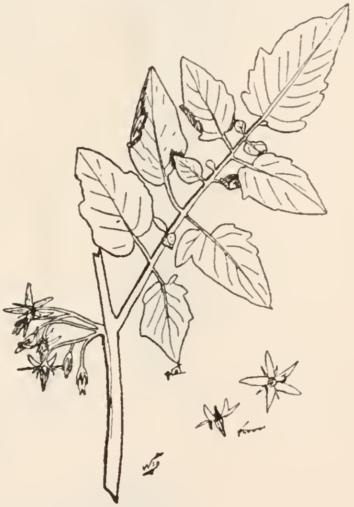


Fig. 414. Tomato (*Lycopersicum esculentum*). An important food plant. (W. S. Dudgeon).

Solanaceae. Nightshade Family

Herbs, rarely shrubs, vines; a few of the tropical species, trees with alternate leaves without stipules; flowers regular or nearly so, borne in cymes; calyx inferior, 5-lobed; corolla gamopetalous, generally 5-lobed; stamens as many as the lobes of the corolla and alternate with them, inserted on the tube, generally equal; style and stigma 1; ovules numerous; fruit a berry or capsule. A large family, chiefly tropical, consisting of 70 genera and 1600 species. Several of these are important medicinal plants and several important food plants. Many plants of the order have poisonous properties.

The red or Cayenne pepper (*Capsicum annuum*), native to North America, is much used in tropical countries to stimulate the appetite. It seems to run to many forms, but has been shown by Prof. Irish that many of the so-called species belong to *C. annuum.* A shrubby species, *C. frutescens,* is native to western Texas and Mexico. The tobacco (*Nicotiana Tabacum*), was undoubtedly native to America. It was used by the Indians in North America at the time of the discovery by Columbus, and was introduced into England in 1585 by Lane who was a deputy of Sir Walter Raleigh. Tobacco is now cultivated in many civilized countries, as Cuba, Philippine Islands, Sumatra, also in Florida, the Carolinas, Connecticut, Kentucky, and Wisconsin in the United States. It is used for making cigars, snuff and for chewing. It is an important article in commerce. The potato (*Solanum tuberosum*) is indigenous to Peru and Chili, but was introduced into Spain about the beginning of the 16th century, and into England from Virginia in 1586 by Sir Walter Raleigh. The greatest yields occur in irrigated districts. It is one of the most important food plants. Other species of tuberous *Solanum* occur, as the *S. Jamesii,* in southwestern United States, and several others in Mexico and South America. The egg-plant (*Solanum Melongena*) is native to India, but is now widely cultivated in tropical countries and temperate regions, the fruit being used for culinary purposes. The tomato (*Lycopersicum esculentum*), a native of tropical America, of which there are many varieties, is now widely distributed in tropical and temperate regions. The fruit is eaten fresh or canned, or made into

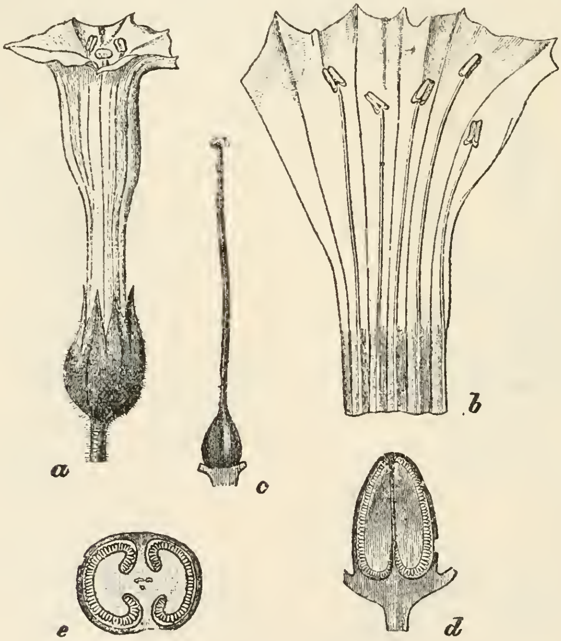


Fig. 414a. Tobacco Plant (*Nicotiana Tabacum*). *a*, Flower; *b*, corolla; cut open; *c*, ovary; *d*, *e*, young fruit. (*a*, *b*, *c*, natural size; d. e. x 2.). (After Strasburger, Noll, Schenck, and Schimper).

various products. The currant tomato (*L. pimpinellifolium*), a fruit about the size of a currant, is cultivated as a curiosity. Ground cherries are much cultivated. The strawberry tomato (*Physalis Alkekengi*), a perennial native to southern Europe, has a large fruiting calyx which turns red. The fruit is eaten, but it is not so palatable as the fruit of the Cape gooseberry (*P. peruviana*), which is native to Peru. The fruit of a native species (*P. pubescens*) is also eaten, but this also is inferior to the Cape gooseberry.

Belladonna is derived from *Atropa Belladonna,* a tall glabrous or slightly downy herb, with a perennial rootstock, native to southern Europe and eastward to Asia Minor. This furnishes the *atropin* of commerce used for dilating the pupil of the eye. The earliest investigations of the alkaloids of belladonna were made by Bauberlein in 1809, who first determined their presence. Esse was the first to find *atropamin* $C_{17}H_{21}NO_2$, in the roots of the plant, although Schmidt denies the presence of *atropin,* affirming the presence of *hyoscyamin* only. *Belladonnin,* an isomer of the above, is probably also present. The root of *Atropa Belladonna* sometimes contains from 4/10-1% of the alkaloid and the leaves about half as much. The greatest amount of the alkaloid occurs during the flowering period. *Pseudo-hyoscyamin* occurs in the roots of *Mandragora.* The alkaloids *mandragorin,* $C_{11}H_{19}NO_2$, and *manacin* $C_{22}H_{33}N_2O_{10}$, occur in *Brunfelsia Hopeana.* Several other undetermined alkaloids, such as *jurubebin,* have also been found in the family.

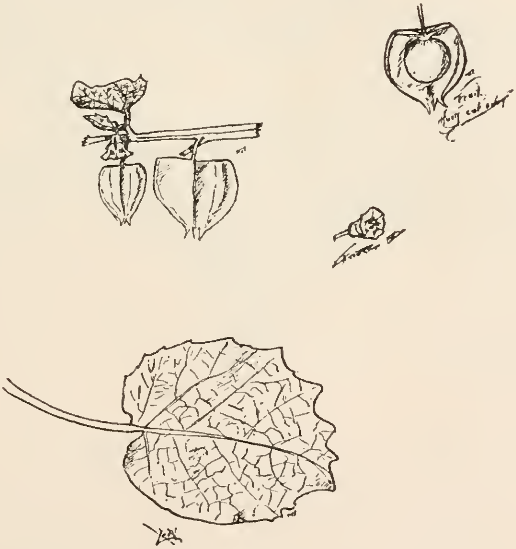


Fig. 415. Ground Cherry (*Physalis viscosa*). Cultivated for its fruit. (W. S. Dudgeon).

The mandrake (*Mandragora officinarum*) of the ancients was, at one time, supposed to have medicinal virtues. The flowering tobacco (*Nicotiana alata*) is a well known cultivated plant of Brazil. The thorn apple (*Datura Metel*) is much cultivated, as is the *D. meteloides,* which has large, sweet-scented flowers. The bittersweet (*Solanum Dulcamara*), the hardy annual (*Schizanthus pinnatus*), the *Brunfelsia latifolia,* which has fragrant flowers, and the *Cestrum*

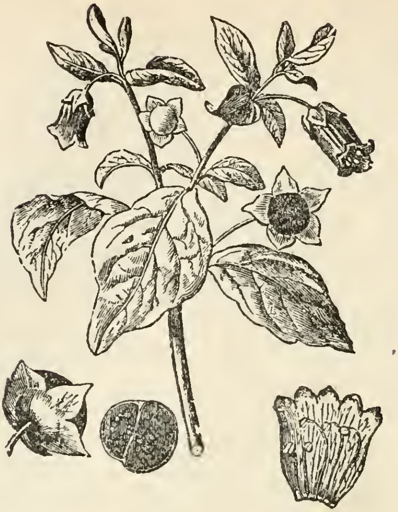


Fig. 416. Sleeping or Deadly Night-shade (*Atropa Belladonna*). Tip of flowering and fruiting branch; entire fruit; cross section of fruit; corolla cut open and spread out. Source of the belladonna of commerce. (From Vesque's Traité de Botanique).

elegans are frequently cultivated. The odor from the flowers of the latter is very overpowering. The berries of *C. pallidum* are said to be poisonous, but birds have scattered the plant very widely in the tropics. *Petunia violacea, Lycium halimifolium* and *L. chinense* are cultivated. The *Duboisia myoporoides* of Australia is a tall shrub, its leaves having narcotic properties and containing the substance *duboisin,* a mixture of *hyoscyamin* and *atropin* producing an action like that of *hyoscyamus* but more hypnotic. According to Maiden this plant is poisonous to stock. Other species like *D. Leichardtii* contain the same substance. The piturie (*D. Hopwoodii*) contains a liquid volatile alkaloid *piturin* C_6H_8N resembling *nicotin.* The natives mix the piturie leaves with the ashes of some other plant and chew them like tobacco. In its action it resembles *nicotin.*

The scopola (*Scopolia carniolica*) of Austria and Hungary, is a perennial herb used like Belladonna in medicine. The leaves and rhizomes of this species and *S. japonica* are poisonous. The *S. carniolica* plant contains *atropin* $C_{17}H_{21}NO_4$, *hyoscyamin* and *scopalamin.* The latter substance is broken up into *scopolin* $C_8H_{13}NO_2$ and *tropic acid* $C_9H_{10}O_3$. The *hyoscin* $C_{17}H_{23}NO_3$ is impure *scopolamin. Scopalin* causes dilation of the pupils; the heart action is at first diminished, then increased, due to the stimulation of the inhibitory nervous apparatus. The pichi used in kidney troubles is the dried leafy twigs of the Chilian shrub (*Fabiana imbricata*). The tree tomato (*Cyphomandra betacea*) produces a fruit similar, in taste, to that of the common tomato, if eaten when raw; but after it is stewed, provided the skin and seeds have first been removed, an apricot-like flavor is produced. It is much used in tarts and pastry in the mountainous districts of the tropics.

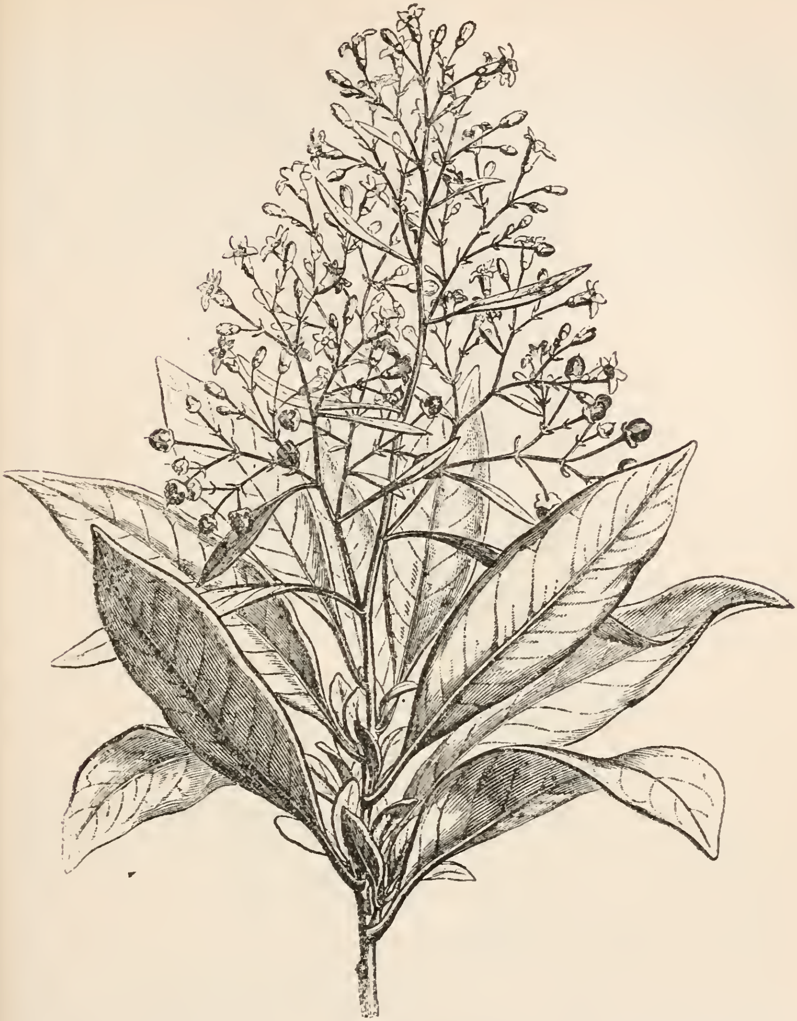


Fig 417. Corkwood (*Duboisia myoporoides*). A shrub, bearing leaves that possess narcotic qualities. (After Faguet).

Genera of *Solanaceae*

Fruit a berry.

Corolla wheel shaped.

Anthers opening by uplifted valves........................1 Solanum

Anthers opening longitudinally, widely spreading............2 Capsicum

Corolla not wheel shaped...5 Nicandra

Corolla funnel form..7 Lycium

Fruit a capsule.

Calyx urn shaped somewhat irregular........................4 Hyoscyamus

Calyx prismatic, corolla funnel form..............................6 Datura

Calyx tubular...5 Nicotiana

1. *Solanum* (Tourn.) L. Nightshade

Herbs or shrubs, often with stellate pubescence; flowers in cymose, umbellate, or racemose clusters; calyx bell-shaped or rotate generally 5-parted or 5-cleft, corolla rotate 5-lobed or cleft, plaited in the bud; stamens exserted, filaments short inserted on the throat, anthers converging around the style opening at the top; ovary usually 2-celled, stigma small; berry with persistent calyx at the base or enclosing it; seeds numerous. About 900 species of wide distribution. Several are troublesome weeds as horse nettle (*Solanum carolinense*) and buffalo bur (*S. rostratum*). The potato (*S. tuberosum*) and egg-plant (*S. Melongena*), are cultivated.

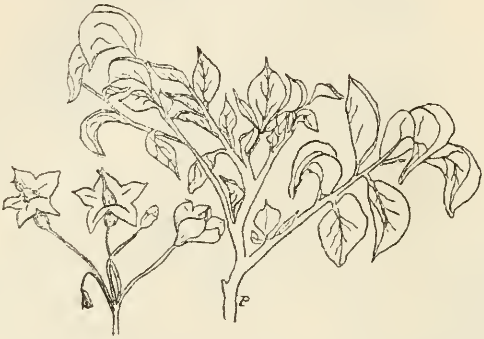


Fig. 418. Common potato (***Solanum tuberosum***). The potato under some conditions is very poisonous, especially when the tops are green. (Lois Pammel).

Solanum Dulcamara L. Bittersweet

A more or less pubescent perennial, stem climbing or straggling, somewhat woody below; leaves petioled ovate or hastate, the upper usually halberd shaped; flowers purple or blue in cymes; berry globose, red.

Distribution. Naturalized from Europe, New Brunswick to New Jersey, Pennsylvania, Kansas to Minnesota.

Poisonous properties. The plant contains the alkaloid *solanin* $C_{28}H_{48}NO_{11}+H_2O$, with a hot, bitter taste, *dulcamarin* a bitter principle $C_{22}H_{34}O_{10}+20H_2O$ and the alkaloids *solanidin* $C_{40}H_{61}NO$ and *solanein* $C_{52}H_{33}NO_{13}$.

Chesnut says with reference to this plant:

> Besides *solanin*, (0.3 percent), this plant contains another less poisonous compound. *dulcamarin*, which gives it its peculiar bitter-sweet taste. Neither of the compounds is abundant. The berry, though its taste is not remarkably disagreeable, is somewhat poisonous, and it has been shown that an extract of the leaves is moderately so. The plant has nevertheless caused some ill effect. The treatment is the same used in case of the above species.

According to Schimpfky the berries of this plant have been used to poison dogs and the juice of the fruit acts as a poison to rabbits. Flückiger and Hanbury in their Pharmacographia, make this statement with reference to Dulcamara:

> Dulcamara is occasionally given in the form of decoction, in rheumatic or cutaneous affections; but its real action, according to Garrod, is unknown. This physician remarks that it does not dilate the pupil or produce dryness of the throat like belladonna, henbane or stramonium. He has given to a patient 3 pints of the decoction per diem without any marked action, and has also administered as much as half a pound of the fresh berries with no ill effect.

Johnson in his Medical Botany of North America refers to the use of the plant as follows:

> Bittersweet, in full doses, produces a certain amount of cerebral disturbance of a narcotic character, together with dryness of the throat, and sometimes an erythematous eruption of the skin, with a tendency to diaphoresis. It has been employed with benefit in a variety of cutaneous eruptions, in muscular rheumatism, and in chronic bronchial and pulmonary affections.

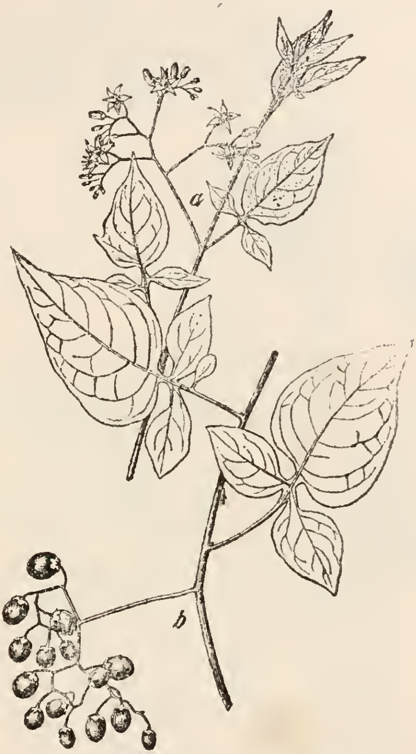


Fig. 419. Bittersweet (*Solanum Dulcamara*). a, flowering spray; b, fruit—both one-third natural size. Berries somewhat poisonous. (U. S. Dept. Agr.).

Lehmann states that it is a narcotic poison when given in large doses, even causing death in rabbits.

It will be seen from the above quotations that the plant is not a violent poison and yet ill effects are probably produced by it under some conditions.

Solanum nigrum L. Common Nightshade or Stubbleberry.

Annual, low branched and often spreading; stem glabrous or hairy, hairs simple, roughened on the angles; leaves ovate, petioled, flowers white in small, umbel-like drooping lateral clusters; calyx spreading, the lobes obtuse, much shorter than the white corolla; berries glabrous, globose, black; occasionally large.

Distribution. Found in northern United States. Also occurs in Europe. Shady grounds and fields. A cosmopolitan weed.

Poisonous properties. Stubbleberries are occasionally cultivated for their fruit. They are sometimes sold as huckleberries and used for pies and pre-

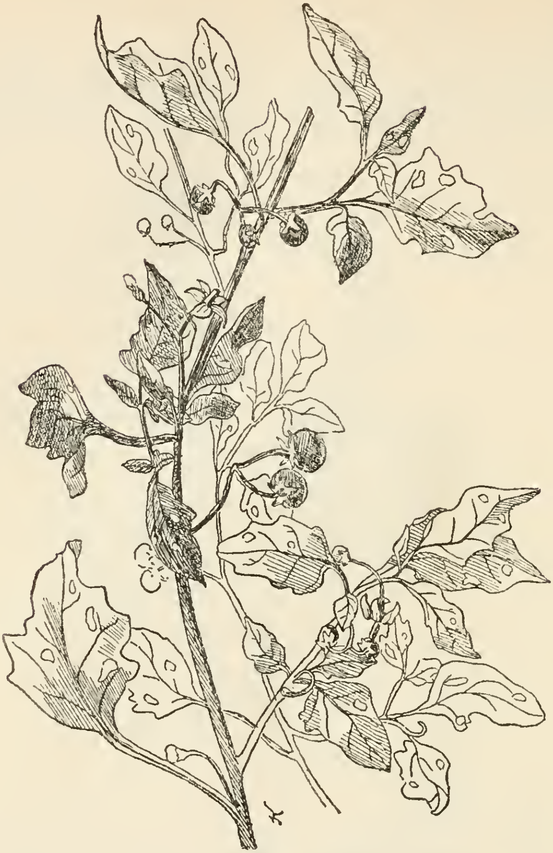


Fig. 420. Black Night-shade (*Solanum nigrum*). Unripe fruit thought to be poisonous. (Charlotte M. King).

serves. The fruit should, however, be used with caution, especially before it is ripe. A decoction of the ripe stubbleberry when fed to cats does not appear to be poisonous, according to Dr. Buchanan, who fed considerable quantities to cats in the writer's laboratory without injurious effects. Mr. Chesnut says:

> The amount of poison present in any part of this plant varies with the conditions of growth. The more musky-odored plants are the most poisonous. In some, the amount of alkaloid in the ripe fruit and leaves is so small that these parts may be, and are, consumed in considerable quantity without any ill consequences. Poisoning does sometimes follow, but it is not clear whether this is due to improper preparation or to careless selection of the parts used. The use of black nightshade for food is certainly not to be recommended. Cases of poisoning are recorded for calves, sheep, goats and swine.
>
> The characteristic symptoms are about the same in man and animals. They are stupefaction, staggering, loss of speech, feeling and consciousness; cramps, and sometimes convulsions. The pupil of the eye is generally dilated. Death is directly due to a paralysis of the lungs, but fortunately few cases are fatal.

In June, Dr. Flickinger reported from Greenfield, Iowa, several cases of sheep poisoning probably due to eating plants of *Solanum nigrum*. A subscriber of the Iowa Homestead also says that for a number of years poisoning has affected his sheep in a pasture where this weed has been abundant. Dr. Koto, Iowa State Veterinarian, also reports cases due to this plant.

This Black Nightshade contains the alkaloid *solanin* $C_{52}H_{97}NO_{18}$ which is probably present in larger quantities in the fruit before it is entirely ripe, also *solanidin* $C_{39}H_{61}NO_2$ with stronger basic properties. From all the evidence I can get, I may say that the fruit should be eaten with caution. In Europe it has been looked upon with suspicion for a long time. The ancients held it in suspicion and many superstitious beliefs were connected with it. Schimpfky in discussing the poisonous and non-poisonous action of the plant states that the amount of poison produced depends upon climatic conditions and the character of the soil. In some places it may be entirely harmless and in other places poisonous. In Europe the plant is sometimes used as a salad plant, but the author above referred to, remarks that when the odor is unpleasant and disagreeable it should not be eaten.

According to Lehmann, Schreber and Haller the berries are poisonous to ducks and chickens. Cases of poisoning from the berries of this plant have been recorded in Europe by Hirtz,[1] Manners,[2] etc.

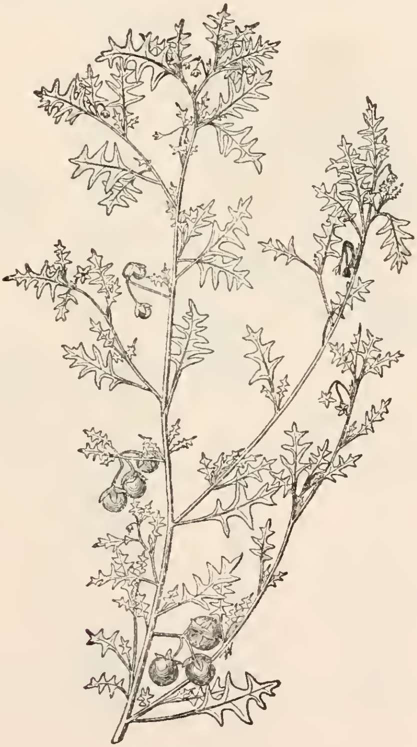


Fig. 421. Spreading nightshade (*Solanum triflorum*), one-third natural size. Suspected of being poisonous. (U. S. Dept. Agr.).

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[1] Gaz. Med. d. Strasbourg. 1842.

[2] Edin. Med. Jour. 1867.

For these and other references see Blyth "Poisons" 4th ed., 398. Poisoning by bitter sweet berries is recorded in Lancet, 1856. Berries of *S. tuberosum*, Brit. Med. Jour. 1895.

Solanum triflorum Nutt. Three-flowered Nightshade

Annual, low spreading, slightly hairy or nearly glabrous; leaves acute; pinnatifid, 7-9 lobed; peduncles 1-3 flowered; corolla white; berries greenish or inclined to blackish, about the size of a small cherry; pedicels reflexed in fruit.

Distribution. On the plains, and waste places from Nebraska and Kansas to Northwest Territory and Arizona; introduced eastward.

Poisonous properties. Prof. Chesnut says experiments on guinea pigs show that the berries are poisonous. No cases of human poisoning have been reported. The berry is not attractive to the eye, but has an agreeable odor and taste. It is therefore to be suspected in cases of poisoning which occur in localities where the weed is abundant. The writer has also received complaints of the poisoning by this plant from Nebraska and other western states. The active constituent is, no doubt, *solanin.*

Solanum rostratum Dunal. Buffalo Bur. Sand Bur

Herbaceous, woody when old; somewhat hoary or yellowish; 8 inches to 2 feet high; covered with copious stellate pubescence; the branches and stems covered with sharp yellow prickles; leaves somewhat melon like, 1-3 times

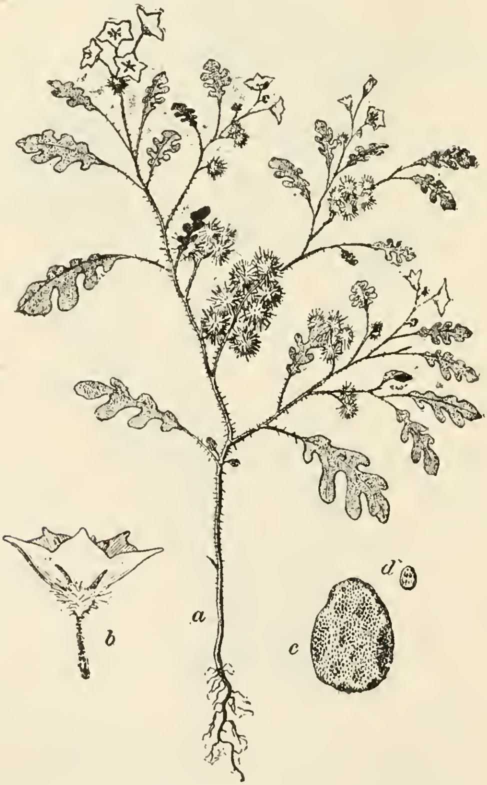

Fig. 422. Buffalo Bur (*Solanum rostratum*). a, branches of the plant with burs; b, yellow flowers; c and d, seeds; c, very much enlarged; d, natural size. The prickles cause mechanical injuries to stock.

pinnatifid; lobes roundish or obtuse and repand, covered with soft pubescence. hairs stellate; flowers yellow; corolla gamopetalous, 1 inch in diameter, nearly regular, the sharp lobes of the corolla broadly ovate; stamens, 5, declined, anthers tapering upward, linear lanceolate, dissimilar, the lowest much larger and longer with incurved beak, hence the technical name *rostratum*; style much declined; fruit a berry but enclosed by the close fitting and prickly calyx, which has suggested the common name buffalo bur or sand bur; pedicels in fruit erect; seeds thick, irregular, round or somewhat longer than broad, wrinkled showing numerous small pits; seeds surrounded by a gelatinous substance. The related' species *S. citrullifolium* of the southwest is glandular pubescent with slender yellow subulate prickles, lowest anther violet.

Distribution. The buffalo bur was undoubtedly a native to the region of the plains occurring in the bare places where grass is scant and in former times was most abundant around the "buffalo wallows." Its range is from New Mexico to Wyoming and across the plains. The general traffic from the west to the east has caused the weed to be distributed in various eastern and middle states, Iowa, Minnesota, Wisconsin, Missouri, Illinois, Indiana, Ohio, New York, Massachusetts and Tennessee.

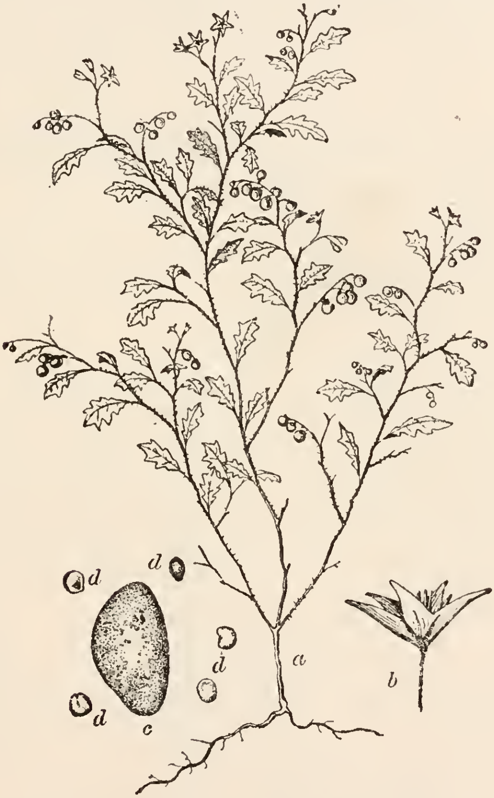

Fig. 423. Horse nettle (*Solanum carolinense*). a, plant with flowers and fruit; b, flower; c, seed enlarged. Considered poisonous by Bessey and others. (U. S. Dept. Agr.).

Injurious properties. This plant is carefully avoided by stock, but so far as known is not poisonous although the prickles on the plant produce mechanical injuries. When the prickles enter the tissues of animals inflammation occurs and pus is formed.

Solanum carolinense L. Horse Nettle

Horse nettle is a deep rooting perennial, propagating freely by its underground roots; these running roots are often 3 feet long; stem from 1-2 feet high, somewhat straggling, half shrubby at the base; stems hairy or merely roughish with minute hairs which are usually numerous; leaves oblong or sometimes ovate, obtusely sinuate, toothed or lobed or deeply cut, 2-4 inches long; flowers borne in racemes which later become 1-sided; the outer part of the flower, the calyx, consists of slender lobes; the corolla is light blue or white, an inch or less in diameter and resembles that of the common potato; the flowers are followed by yellow globose berries, 1/2-3/4 inch in diameter; the small seeds are yellowish, a little less than 1/12 of an inch long, minutely roughened.

Distribution. Its distribution in North America is from Connecticut through New York, Pennsylvania and New Jersey, West Virginia along the Atlantic seacoast to Florida, west along the Gulf Coast to Texas, through Kansas, Nebraska, Iowa, Illinois and Michigan.

Poisonous properties. The root as well as the fruit of the plant has a very disagreeable narcotic odor; according to several authors, the plant is poisonous. Dr. Bessey reports it as possibly poisonous. It contains *solanin,* according to Kraemer, 0.8 per cent in the berries.

Solanum elaeagnifolium Cav. Horse-weed. Bull Nettle

A deep-rooted spreading perennial from 1-3 feet high; stem silvery canescent, finely pubescent; leaves lanceolate, oblong or linear, petioled entire or repand-dentate; flowers in cymose clusters; peduncle stout and short; corolla gamopetalous, blue; calyx lobes lanceolate; berry yellow, smooth globose.

Distribution. Common on the prairies of Kansas to Texas and New Mexico.

Poisonous properties. The berries of this fruit are used to curdle milk in northern Mexico and southern Texas. They are crushed into a powder, put into a muslin bag, suspended in the milk until coagulation occurs. It is also used as a medicine by the Mexicans.

Solanum tuberosum L. Potato

An erect herb, cultivated as an annual for the esculent tubers; leaves pinnate of several ovate leaflets and smaller ones between; flowers blue or white, berries round, green.

Distribution. Native to Chile north to Mexico and Arizona. Introduced into Europe between 1580 and 1585.

Poisonous properties. The wilted green stem and leaves are poisonous, containing the alkaloid *solanin.* The water from boiled potatoes contains a poisonous substance. Some persons cannot eat potatoes because poisonous to them. According to Kassner, healthy potatoes do not contain *solanin* but diseased potatoes contain this substance; from 150 gms. he separated 30-50 mgrs. of *solanin.* It is probable that this substance occurs in other species of *Solanum.* Thos. Maiden states that the *S. eremophilum* poisons sheep and cattle when they eat the tops. Friedberger and Fröhner state that potato tops are injurious; that the diseased animals show symptoms resembling foot and mouth disease.

Dr. Doerr has recently reported a case of poisoning in a cow that had been fed exclusively upon refuse from the Club-house kitchens near the Iowa State College Campus. These contained potato parings among other things and to these the poisoning was charged. The trouble was diagnosed as gastro-enteritis. The post-mortem revealed diffuse intestinal hemorrhages with enlarged liver and spleen.

2. *Capsicum.* Pepper

Herbs or shrubs with sharp taste; leaves fleshy; flowers white; corolla wheel shaped; 5-lobed; tube short; stamens separate with filaments longer than the heart shaped anthers which open longitudinally; fruit a berry. The Guinea pepper and the Indian goat pepper (*C. frutescens*) are much more powerful stimulants than cayenne and often produce violent pain and purging. This shrub is native to the Southwest. The genus *Capsicum* has two species. A monograph by Prof. Irish published in the Missouri Botanical Garden Reports describes many of the varieties.

Capsicum annuum L. Cayenne Pepper

Annual. Leaves ovate entire; flowers with truncate calyx and white corolla; fruit a berry, oblong or globular, red or green.

Distribution. Widely cultivated. Native to the Southwest.

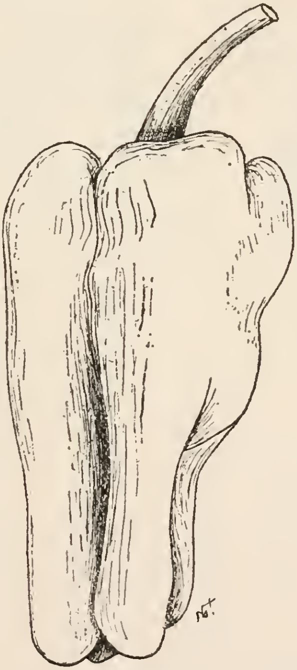

Fig. 424. Red Pepper (*Capsicum annuum*). The fruit of this as well as the leaves are powerfully pungent. (W. S. Dudgeon).

Poisonous properties. The peppers are often used in domestic practice in making a stimulating plaster; if its action is continued long enough, however, a vesicular formation makes its appearance. In domestic animals it causes gastro-enteritis. Death has even occurred where too much of the Cayenne pepper has been used. Thresh isolated a principle to which he gave the name of *capsaicin* $C_9H_{14}NO_2$, however, the bitter pungent substance has been called by Morbitz, *capsacutin*, a crystalline nitrogenous compound containing the substance $C_{35}H_{54}N_3O_4$. This is so powerful that 1 part in 11,000,000 will impart the pungent taste. A volatile alkaloid resembling *coniin* has been found in small quantities.

3. *Nicandra* Adans. Apple of Peru

Tall smooth annual with alternate leaves, calyx 5-parted, angled; corolla wheel shaped or somewhat funnel shaped with widely spreading border; tube short; anthers 5 connivent; fruit a somewhat 3-5 celled berry.

Nicandra Physalodes (L.) Pers. Apple of Peru

A tall smooth annual, 2-5 feet high; leaves ovate angled or sinuate toothed; flowers solitary; corolla pale blue rather large; fruit a globular dry berry; calyx, 5-parted, 5-angled, enlarged and bladder like in fruit.

Distribution. Native to Peru but sparingly naturalized in the United States.

Poisonous properties. Said to be poisonous; used as a fly poison in parts of the United States.

4. *Hyoscyamus* (Tourn.) L. Henbane

Clammy-pubescent, fetid, narcotic herbs; leaves alternate, mostly lobed or pinnatifid; flowers large, calyx bell-shaped or urn-shaped, 5-lobed; corolla funnelform, oblique; 5-cleft, the lobes unequal; capsule enclosed in the persistent calyx, 2-celled.

About 15 species, native to the Mediterranean region. Medicinal and poisonous plants.

Hyoscyamus niger L. Black Henbane

Biennial or annual. Stem 1-3 feet high; leaves ovate, sinuate toothed and angled, the upper clasping; flowers short pedicelled in one sided leafy spikes; corolla dull yellowish, reticulated, with purple veins; capsule globose oblong.

Distribution. Common only eastward in waste places from Nova Scotia to Michigan, also in Montana, Utah, Idaho and the Pacific Coast.

Poisonous properties. A well known medicinal plant from which *hyoscyamin* is obtained. *Hyoscyamin* is an anodyne and hypnotic and is poisonous. Dr. Chesnut says:

> One or two cases are recorded in foreign literature in which stock have been poisoned by eating the plant of their own accord, but there is very little danger from it, on account of its ill odor and harsh texture.

It contains *hyoscyamin*, $C_{17}H_{23}NO_3$, causing a dilation of the pupils and having a sharp and disagreeable taste. It also contains *pseudo-hyoscyamin* $C_{17}H_{23}NO_3$, another alkaloid, and *hyoscin* $C_{17}H_{23}NO_3$; the latter of which also dilates the pupils. The *hyoscyamin* resembles *atropin* in its composition and action and is obtained from the *Hyoscyamus* seed. When damp the alkaloid has a tobacco-like odor and a bitter taste. According to Dr. Winslow, the *hyocsyamin* is practically *atropin* except that its mydriatic action is shorter. *Hyoscin* is a powerful depressant to the cerebrum, respiratory center, spinal reflex centers, and motor tract. It is a cerebral sedative. According to Winslow:

> The tetanic stage succeeding spinal paralysis, observed in *atropin* $C_{17}H_{23}NO_3$ poisoning, does not ensue with *hyoscin*. The latter alkaloid slightly depresses and slows the

heart, and does not paralyze the vagus terminations, nor depress the motor and sensory nerves or muscles. The circulation is but slightly influenced, and vasomotor depression only occurs in the latter stage of lethal poisoning. Death occurs from paralysis of the respiratory centers. Poisoning in animals is exhibited by loss of muscular power, slowing and failure of respiration, dryness of the mouth, stupor and asphyxia. The pulse may be infrequent, the pupils are dilated and the skin is moist rather than dry. Delirium and convulsions sometimes occur in man. The effect of the combined action of *hyoscyamin* and *hyoscin* in *Hyoscyamus* is shown when we compare the drug with belladonna. *Hyoscyamus* is more of a cerebral sedative and hypnotic, and less of a heart and respiratory stimulant. It is said to possess more power in overcoming spasm, and griping of cathartics, and in aiding intestinal movement. *Hyoscyamus* is also thought to exert a more pronounced antispasmodic action than *belladonna* upon the smooth muscles of the bladder and urethra.

Blyth gives the action of *hyoscyamin* as follows:

Thirty-two mgrs. (½ gr.) begins to act within a quarter of an hour, the face flushes, the pupils dilate, there is no excitement, all muscular motion is enfeebled, and the patient remains quiet for many hours; 64.8 mgrs. would possibly be a fatal dose. The root is more poisonous than the leaves, and the seeds of *Datura* contain a considerable quantity of *hyoscyamin*; they are often mistaken for other seeds such as poppy.

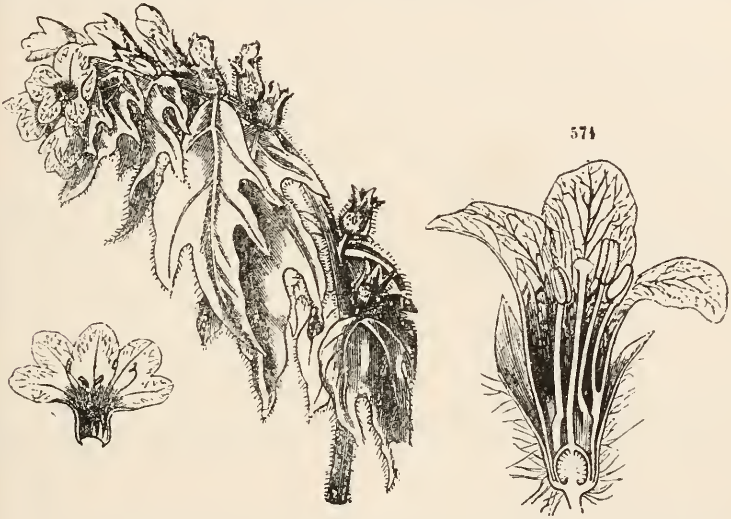

Fig. 425. Black Henbane. (*Hyoscyamus niger*). At the left, open corolla, and flowering branch. At the right, longitudinal section of flower. A well known medicinal plant. (From Vesque's Traité de Botanique).

Many cases of children being poisoned by this seed are recorded. One instance is given by Schimfky where of two children who had eaten the seeds of the plant, one died before purgative action could be produced. The second child slowly recovered but growth was checked.

5. *Nicotiana* (Tourn.) L. Tobacco

Rank, viscid-pubescent narcotic herbs or shrubs; leaves alternate, entire; flowers borne in panicled racemes; calyx tubular, bell-shaped, 5-cleft; corolla funnel-form or salver-form, the limb with five separating lobes; stamens 5, inserted on the tube of the corolla; dehiscence of the anthers longitudinal; ovary 2-celled; stigma capitate; capsule 2-valved; seeds numerous, small. About 50 species nearly all native of North America.

Nicotiana Tabacum L. Common Tobacco

A coarse annual from 4-6 feet high; leaves lanceolate, ovate, decurrent, 1-2 feet long; flowers panicled, rose-purple; corolla funnel-form, 2 inches long; lobes short, somewhat inflated.

Distribution. Native to South America but widely cultivated; introduced into Europe by the Spaniards shortly after the discovery of America. The best types of tobacco are cultivated in Cuba and Porto Rico; and this forms an extensive industry in North America, especially in Connecticut, Wisconsin, Virginia, etc.

Poisonous properties. Various opinions are expressed in regard to its poisonous properties. It is known, however, that an alkaloid occurs in *N. Tabacum*, *N. macrophylla*, *N. rustica* and *N. glutinosa*, which apparently does not occur in any other plant.

The active principle of the tobacco leaf is the alkaloid *nicotin* $C_{10}H_{14}N_2$, which is easily extracted from tobacco by means of alcohol or water; it occurs to the extent of 6 per cent in the dry leaves; it has a sharp, burning taste, is very poisonous and is said to have sixteen times the toxic power of *coniin*. On application of heat, *nicotin* is changed into *pyridin*, C_5H_5N, and other similar alkaloids like *picolin*, CHN. *Pyridin* depresses the spinal motor tract and causes paralysis of respiration. Moderate doses cause contraction of the pupil. *Nicotein* $C_{10}H_{12}N_2$ was found by Pictet and Rotschy in leaves of tobacco; also *nicotemin* $C_{10}H_{14}N_2$, and *nicotellin* $C_{10}H_8N_2$. According to more recent investigations the seeds of *Nicotiana* are free of *nicotin*. The following statement is made with reference to the toxicology of *nicotin* by Dr. Winslow:

> Nicotin is one of the most powerful and rapidly acting poisons. When swallowed, it causes, in animals, local irritation and pain in the throat and stomach; muscular tremors and weakness, on account of which the animal falls. These symptoms are followed, first, by severe tonic and clonic convulsions, and then by abolition of voluntary motion and quietude. The pupils are contracted, and there is vomiting (in the case of some animals), purging and micturition. The respiration is at first shallow and rapid, but becomes weaker and slower, and death occurs from respiratory failure and general collapse. The pulse is primarily slow and intermittent, but later becomes rapid. The treatment of poisoning consists in evacuation of the stomach; the use of tannic acid; respiratory and heart stimulants, as *strychnin*, *atropin*, and *alcohol*; together with external heat and artificial respiration. The minimum lethal dose is about one drachm of tobacco, or one minim of nicotine, for small dogs. For horses, five to ten drops of *nicotin* or one-half pound of tobacco.

Friedberger and Fröhner state that animals have convulsive spasms, great muscular weakness, with acute paralysis.

The chronic effects of the use of tobacco, according to Millspaugh, are as follows:

> The effects produced upon smokers are almost useless in the study of the drug itself, and it is only in that class of chewers who swallow the juice, that positive data could be looked for; still here, as well, we are at a loss to determine facts, for in manufacturing the narcotic, processes are used which alter the product greatly; nevertheless some few symptoms seem to be more or less common to all who have been, for protracted periods, subjected to the drug. Mental anxiety and irritability, with at times confusion of ideas; dilation of the pupils; ringing in the ears; increased secretion of saliva; uncertainty of speech. dryness of the throat; at times weakness of the stomach and nausea; increased secretion of urine; dry cough especially at night; præcordial oppression with palpitation of the heart and at times an irregular pulse; trembling of the extremities when held long in one position; general anæmic condition of the blood spasmodic contraction or jactation of single muscles; sensations of exhaustion and especially lassitude; sleepiness; profuse perspiration and sensitiveness to cold.

A writer in the London Lancet quoting from the Therapeutic Gazette[*] states that the injury from tobacco smoke comes largely from the inhalation of carbon monoxide. Cigarette smoking is more harmful than smoking a pipe because more of the gas is inhaled.

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[*] Vol. 32:786.

According to Zalackas, *eserin* and *strychnin* are not antagonistic to *nicotin* but the juice of *Nasturtium officinale* counteracts it.

Nicotiana rustica L. Wild Tobacco

Annual, with obovate, petioled leaves; flowers greenish-yellow, panicled, longer than the calyx; capsule globose.

Distribution. In fields and waste places from Canada to Florida, and Minnesota. Cultivated by the Indians.

Poisonous properties. Probably the same as those of the preceding species.

Nicotiana alata Link & Otto

An annual, pubescent plant from 3-4 feet high; leaves lanceolate, flowers large tubular; tube 5-6 inches long; the limb deeply 5-cleft.

Distribution. Native to Brazil but a frequent escape in gardens in the east.

Nicotiana quadrivalvis Pursh. Wild Tobacco

An annual 1 or more feet high, leaves oblong or the upper lanceolate and the lower obovate lanceolate, acute at both ends; flowers few; corolla white, tubular funnel-form; tube 1 inch long.

Distribution. Oregon to the plains. Often cultivated by the Indians for tobacco. The allied species, *N. attenuata, Torr.,* is found from Colorado to Nevada and California.

Poisonous properties. The poisonous properties are probably the same as those of common tobacco. According to Maiden the *N. suaveolens* is poisonous to stock in New South Wales.

6. *Datura* L. Thorn Apple. Jimson Weed

Rank-scented, tall, narcotic herbs; or a few tropical shrubs or trees with alternate petioled leaves; large flowers; calyx 5-cleft; corolla funnelform, 5-lobed, the limb plaited; stamens generally included, inserted at or below the middle of the corolla tube; ovary 2-celled, forming a capsule which is globular and prickly.

A small genus of about 12 species of wide distribution, 2 being cosmopolitan weeds. Several of the species are used for ornamental purposes. Among these are the common white-flowered thorn apple (*Datura Metel*) which is native to tropical America, also the *Datura meteloides,* native to New Mexico and cultivated for its large sweet-scented flowers. Several tropical American tree-like shrubs like *Datura suaveolens* are often cultivated in conservatories. The seeds of *D. fastuosa* are used in India as a poison according to Gimlette, and are commonly used on the Malay Peninsula. The *D. alba* is common in India, about Madras, and *D. atrox* occurs on the coast of Malabar. The Daturas are all important in India from the point of view of poisoning. The seeds of *D. alba* are often mistaken and eaten for the seeds of Capsicum.

Datura Tatula L. Purple Thorn-apple or Purple Stramonium

A glabrous annual from a few inches to 5 feet high; stem purplish; leaves thin, ovate, acute or acuminate; flowers consisting of a 5-toothed calyx and a 5-lobed funnel-form corolla, with stamens included; filiform filaments inserted below the middle of the corolla tube; capsule globular, prickly, 4-valved and 2-celled.

Distribution. Abundant in fields and waste places from New England to

Ontario to North Dakota, Nebraska, Texas, and Florida, naturalized from tropical America.

Poisonous properties. The poisonous alkaloids found in this plant are: *atropin* $C_{17}H_{23}NO_3$, *hyoscyamin,* and *hyoscin.* The *daturin* is a mixture of *hyoscyamin* and *atropin.*

Professor Chesnut, in his work on the Poisonous Plants of the United States, referring to the jimson weed, says:

> The poisonous alkaloids, *atropin* and *hyoscyamin,* the active constituents of belladonna are found also in both of the jimson weeds. *Hyoscyamin* is the poison of the henbane and as it is identical in its physiological action with *atropin,* the above-named plants present the same symptoms of poisoning, which must be met in the same manner. The alkaloids exist in all parts of the two daturas. The seeds are especially poisonous.

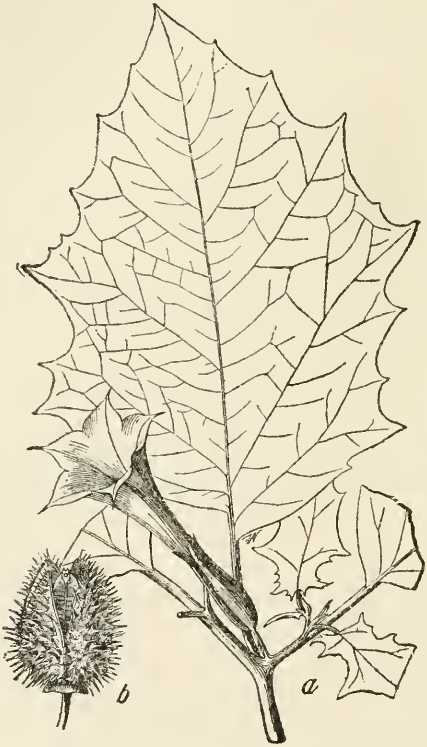

Fig. 426. Jimson Weed (*Datura Stramonium*). *a*, leaf and flowers; *b*, fruiting capsule.

Cases of poisoning arise in adults from excessive use of a stimulant or a medicine. Children are sometimes tempted to eat the fruit, if they are permitted to play where the weed is to be found. Several cases of this kind were reported to the Department during the fall of 1897. At Alpena, Michigan, five children were badly poisoned in August by eating the seeds of the purple-flowered species, which was cultivated in a garden as a curiosity under the fanciful trade name of "Night-blooming Cactus." In Sept. a boy was killed in New York by eating the seeds of a jimson weed, which was permitted to grow in a vacant lot; his brother poisoned at the same time was saved only with difficulty. In October two other cases occurred in New York. Four children were playing in one of the public parks of the city where jimson weeds were growing luxuriantly. The boys imagined themselves Indians and roamed about and ate parts of various plants. Three of them ate the seeds of the jimson weed. One died in a state of wild delirium; another was saved after heroic treatment with chloral hydrate and morphine;

the third, who ate but few of the seeds, was but little affected. Children are also poisoned by sucking the flower, or playing with it in the mouth. The fresh green leaves and also the root have occasionally been cooked by mistake for other wild edible plants. One or two instances are recorded in which cattle have been poisoned by eating the leaves of young plants which were present in grass hay, but these animals generally either avoid the plants or are very resistant to its poison.

The symptoms of the poisoning are about the same in all cases, those characteristic of large doses being headache, vertigo, nausea, extreme thirst, dry, burning skin, and general nervous confusion, with dilated pupils, loss of sight and of voluntary motion, and sometimes mania, convulsions, and death. In smaller amounts the effects are like those of the ordinary narcotics. As vomiting is not a common symptom, the contents of the stomach must be quickly removed by the use of the stomach tube or emetics. It is well then to wash out that organ thoroughly with strong tea, tannic acid, or an infusion of oak bark, and to administer stimulants, such as brandy and hot, strong coffee. *Pilocarpin* is recommended by physicians to counteract the drying effect upon the secretions (licorice is very useful), and prolonged artificial respiration must often be resorted to to maintain the æration of the blood.

As nothing has been said in regard to the *atropin* which is found in the jimson weed, it might be said that the commercial *atropin* is derived from the root of belladonna and when used externally it is a local anodyne. Dilute solutions of *atropin* paralyze and stop the corpuscular movement in the blood and large doses give rise to slowing of the pulse. In poisoning it causes a paralysis of the vascular motor centers and stimulates the brain; large doses produce restlessness and excitement and delirium in man and occasionally delirium in lower animals. With reference to the spinal cord, large doses cause complete loss of motion. Its action upon the nerves is very important and on this depends much of the value of the drug. Dr. Winslow says:

> The peripheral motor nerve terminations, and to a less extent, their trunks, are depressed and paralyzed. This is never so complete, however, but that there is some voluntary power left in an animal fatally poisoned.

Dryness of the mouth is one of the first symptoms following the use of belladonna because of the paralysis of the peripheral terminations of the secretory nerve. The involuntary nerves are not affected by moderate doses of belladonna. The motor nerves ending in the voluntary muscles are paralyzed by poisonous doses of belladonna. Small doses do not affect the respiration, large doses make it quicker and deeper. Fatal doses cause asphyxia. Moderate doses cause a rise of temperature, but fatal doses lessen the bodily heat. Dr. Winslow gives the following summary of the action of the drug:

> It will be observed that belladonna, generally speaking, first stimulates and then depresses the nerve centres, while it chiefly paralyzes the motor nerve terminations, including the inhibitory (vagus and splanchnic), the secretory (Chorda tympani, etc.), and, to a less extent, the sensory nerves. Secondary depression of the cerebrum is not so profound as that of the great medullary centres, especially the respiratory centre, and there is sometimes a slight and brief stimulation of the motor nerves of the smooth muscles, viz., vagus, splanchnic, and possibly vaso-motor nerves.
>
> Full medicinal doses depress the peripheral filaments of the inhibitory and secretory nerves, and those of the unstriped muscles, lessen the functional activity of the voluntary motor system, and, to a less degree, that of the afferent nerves. The pulse becomes quickened because of paralysis of the peripheral vagus endings and stimulation of the heart or its ganglia; the blood tension is augmented because of the increased cardiac action and stimulation of the vasomotor centers; and the respiration is accelerated because of excitation of the respiratory centers. The temperature is elevated owing to the circulatory exaltation and stimulation of the heat-producing centers. Slight delirium may be present from the exciting action of the drug upon the cerebral motor centers.
>
> The spinal cord is unaffected by therapeutic doses. Locally applied, belladonna is a direct paralyzant to nerves, muscles, vessels and cells.
>
> Toxic doses of belladonna cause in animals dryness of the mouth, increased frequency of the pulse and respiration, elevation of temperature, dilation of the pupil and partial blindness, restlessness, nervousness, delirium, twitching of the muscles (occasionally erythema), and

frequent micturition. These symptoms are succeeded, in fatal poisoning, by fall of temperature, retention of urine, muscular weakness, staggering gait, partial anæsthesia, convulsions and paralysis (one preponderating over the other), weak, slow, irregular respiration, feeble, rapid pulse, paralysis of the sphincters, stupor and death. Death occurs mainly from asphyxia, but is due in part to cardiac failure. The physiological test consists in placing a drop of urine (secreted by the poisoned animal) into the eye of a healthy animal, when mydriasis should follow if the case be one of belladonna poisoning. Three-quarters of a grain of *atropin* under the skin has proved fatal to dogs. Two grains of *atropin* produce mild toxic symptoms in the horse. Small dogs are slightly poisoned by gr. 1-80 of *atropin*; medium sized dogs by gr. 1-60, given hypodermatically. Cattle are as susceptible as horses, although herbivora are not so easily influenced as carnivora. The pulse in dogs is greatly accelerated, sometimes as high as 400, while the pulse rate of the horse is not generally more than doubled. Rodents, as guinea pigs and rabbits, and pigeons, are particularly insusceptible to belladonna, in regard to its effect upon the pupil, circulation, etc.

The treatment for poisoning includes the use of the stomach pump, emetics, cardiac stimulants, and *pilocarpin* under the skin. Also external heat, general faradism and artificial respiration.

Datura Stramonium L. Jamestown or Jimson Weed

Much like the last; an annual; glabrous or the young stem somewhat pubescent, stout and green; branches and leaves sparingly pubescent; leaves thin ovate, sinuate toothed or angled; calyx less than ½ the length of the corolla; corolla white, 3 inches long, the border 5-toothed; capsule ovoid, prickly, the lower prickles mostly shorter.

Distribution. Nova Scotia, New England to Minnesota, Iowa, Nebraska, Texas and Florida. Naturalized, native to tropical regions of the Old World, probably Asia. De Candolle says that it is probably native to the borders of the Caspian Sea.

Poisonous properties. The *Datura Stramonium* has been used in medicine since the close of the sixteenth century. Earlier than this it was used by the people of western Asia and eastern Europe. Miss Henkel describes the method of collecting as follows:

> The leaves are collected at the time of flowering, the entire plant being cut or pulled up and the leaves stripped and dried in the shade. The unpleasant narcotic odor diminishes upon drying. The leaves are poisonous, causing dilation of the pupil of the eye, and are used principally in asthma.

All three species of *Datura* are poisonous, the seeds being especially poisonous. Dr. Halsted records a case of poisoning of a boy five years old in Newark, New Jersey, who ate freely of a half grown capsule of this species and died the next morning. The seeds of *D. Stramonium* are known to have poisoned a child in eastern Iowa. They contain *hyoscyamin, atropin* and *scopolamin.* In some analyses, as much as 0.33 per cent of the alkaloid *atropin* has been found in the seeds, and about 0.2 per cent in the leaves.

Datura Metel L. Thorn Apple

A clammy pubescent annual 3-4 feet high, leaves ovate, entire or obscurely angular toothed, rounded at the base; flowers large, white, calyx about ½ as long as the corolla; capsule globose prickly.

Distribution. Native to tropical America. Naturalized from New England to Florida and westward.

Datura meteloides DC. Wright's Datura

A spiny pubescent annual, pale in color, leaves obovate entire; flowers large showy, white or pale violet, sweet scented; corolla with a 5-toothed border; capsule nodding spiny.

Poisonous properties. The writer a few years ago saw a notice in a local paper of a child being poisoned by sucking the nectar of a flower of Wright's Datura. Professor Chesnut, in speaking of the poisonous properties of the same species, says:

> *Datura meteloides* is a very large-flowered species, which is native from southern California to Texas, and in some localities is common in cultivaton. No cases of poisoning have yet been recorded against it, but it is largely used as an intoxicant by Indians, and is used in general for the same purposes as jimson weed. It undoubtedly contains the same poisons.

7. *Lycium* L. Matrimony Vine

Shrubs or woody vines, often spiny; leaves small, entire, alternate, with smaller ones between; calyx 3-5 toothed or cleft, persistent, corolla funnelform or salver-shaped, usually 5-lobed, the lobes imbricated; stamens 5 rarely 4; anthers opening lengthwise; style slender; stigma capitate; ovary 2-celled; berry globose, ovoid or oblong.

About 75 species of wide distribution.

Lycium halimifolium Mill. Common Matrimony Vine

A glabrous, spiny, or unarmed shrub; slender climbing or trailing stem; leaves lanceolate, oblong or spatulate; petioles short; peduncles filiform; calyx lobes ovate; corolla short, funnel-form; greenish-purple stamens slightly exserted; berry oval; orange red.

Distribution. In thickets and waste places, escaped from gardens from Canada to Texas. Introduced from Europe.

Poisonous properties. Supposed to be poisonous.

Scrophulariaceae. Figwort Family

Mostly herbs, shrubs or rarely trees; leaves without stipules; flowers perfect, regular or irregular; calyx 4-5 toothed, cleft or divided; corolla irregular 2-lipped or nearly regular; stamens 2-5, didynamous or nearly equal, inserted on the corolla; pistil 1, 2-celled, many ovuled; fruit a capsule; seeds numerous, with a small embryo in copious albumen.

About 2500 species of wide distribution. Few plants of the family are of economic importance. Several species are medicinal. The most important are foxglove (*Digitalis purpurea*); mullein (*Verbascum Thapsus*), used as a stimulant because of its mucilaginous properties, and speedwell or Culver's root or Culver's physic (*Veronica virginica*), used for digestive disorders, when fresh being a violent emetic-cathartic and containing a glucoside *leptandrin.* Several species of the order are cultivated for ornamental purposes. The *Paulownia tomentosa,* native to Japan, is hardy in the south. The foxglove is also much cultivated. Several species of monkey flowers (*Mimulus luteus*) and musk flower (*M. moschatus*) are cultivated. The best known of all is the snap dragon (*Antirrhinum majus*), native to Europe. The genus *Calceolaria,* of which there are numerous species, is native to Chili and other parts of South America, and is cultivated. The *C. crenatiflora* is a showy herbaceous plant cultivated for its pretty slipper-shaped, sac-like flowers. The Maurandias are Mexican climbers with heart-shaped or halberd-shaped leaves and open-mouthed, somewhat bell-shaped, purple, rose-colored, or violet corollas. The *Torenia asiatica,* native to Asia, is cultivated for its handsome pale violet or purple flowers. The turtle-head (*Chelone glabra*) is occasionally cultivated and has large, white or rose-tinted corollas that are very pretty. The beard-tongue (*Penstemon*) contains many species, found mostly in western America and Mexico, the most beautiful of our western species being *P. grandiflorus,* with large, lilac-purple flowers collected in ample racemes. Many of the Rocky Mountain forms are handsome perennials. The Mexican *Russellia juncea* is a showy bedding and greenhouse plant with carmine flowers and leaves reduced to scales. The painted cup (*Castilleia coccinea*) is a pretty species, native of the northern states. The roots of most species are parasitic. The common lousewort (*Pedicularis canadensis*) is an early spring blooming plant of northern prairies. *P. groenlandica* of Europe, is found in the colder regions of North America also and has handsome purple flowers borne in spikes. The flowers of *Lyperia atropurpurea* or Cape Saffron resemble true saffron very greatly in odor, taste and drying qualities.

Vanquelin isolated the glucoside *gratiolin* $C_{40}H_{70}O_{15}$ from *Gratiola officinalis.* This species is poisonous to stock; strong medicinal doses are poisonous to man as well. Some species, according to Maiden, are often poisonous to stock in Australia. The cow wheat of Europe (*Melampyrum arvense*) causes colic and sleepiness.

Genera of *Scrophulariaceae*

Flowers regular or nearly so.
  Flowers racemose, stamens 5.................................1. Verbascum
  Flowers axillary or racemose, stamens 2......................2. Veronica
Flowers irregular.
  Stamens 4 not in pairs.
    Corolla spurred ....2. Linaria
    Corolla not spurred.
      Tubular ....3. Digitalis
      Bell-shaped ....4. Gerardia
  Stamens in pairs..5. Pedicularis

1. *Verbascum* (Tourn.) L. Mullein

Biennial or perennial, generally tall herbs with alternate leaves; flowers in spikes, racemes or panicles; calyx 5-parted; corolla flat with 5 broad rounded or slightly unequal divisions; stamens 5, inserted on the base of the corolla. unequal; filaments of all of the stamens woolly or only the 3 upper; style flattened at the apex; fruit a capsule, 2-valved; seeds rough.

About 125 Old World species. Several naturalized in North America.

Verbascum Thapsus L. Common Mullein

A tall, densely woolly annual from 2-6 feet high; leaves oblong, thick, covered with branched hairs, the basal leaves margined petioled; flowers in long dense spikes; corolla rotate, yellow or rarely white; stamens unequal, the 3 upper shorter, woolly with short anthers; the 2 lower smooth with large anthers.

Distribution. From Nova Scotia north across the continent; south to Missouri and Kansas and west to Utah.

Verbascum Blattaria L. Moth Mullein

Stem round, sparingly branched, biennial with smooth leaves, the lower petioled, oblong, ovate, lanceolate, laciniate, serrate, upper clasping; flowers in loose racemes, yellow or white with a tinge of purple; all the stamens bearded with violet hairs; capsule nearly globose; numerous seeds.

Distribution. Common eastward, rarely in the Mississippi Valley. Abundant in the west in Salt Lake basin.

Poisonous properties. The common mullein produces an irritation but is probably not very poisonous to stock.

2. *Linaria* (Tourn.) Hill. Toad Flax

Herbs or shrubs, with alternate leaves, or those of the sterile shoots opposite or whorled; flowers in racemes or spikes: calyx 5-parted; corolla personate and with a spur at the base; the upper lip erect, 2-lobed, the lower 3-lobed; stamens 4, didynamous, not exserted; fruit a capsule, opening by 1 or more holes in the top; seeds small, numerous.

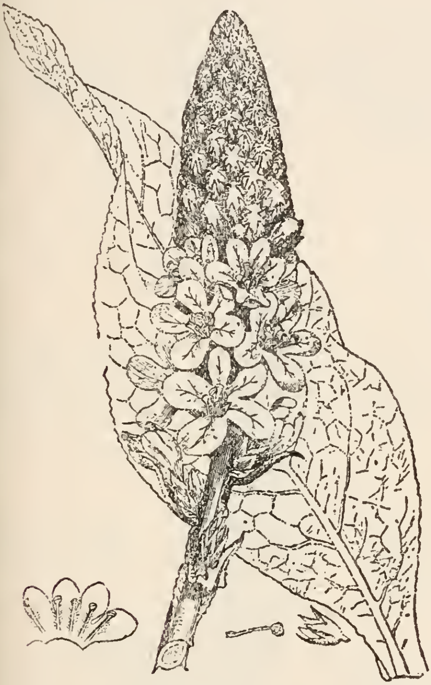

Fig. 427. Verbascum Thapsus. (From Johnson's Medical Botany of N. A.).

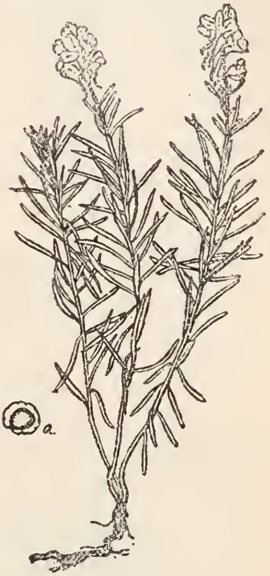

Fig. 428. Toad flax (*Linaria vulgaris*). a, seed. Regarded with suspicion. (Selby).

About 150 species of wide distribution. One native species in the northern states.

Linaria vulgaris Hill. Ramsted. Butter and Eggs.

A pale green perennial with erect, leafy globose or sparingly pubescent stem; leaves sessile, entire, upper, at least, alternate; flowers in dense racemes; calyx segment oblong, spur subulate; corolla orange color, nearly erect, 1 inch long, spur subulate, nearly as long as the body of the corolla.

Distribution. Native to Europe. In fields and waste places from Nova Scotia to Kansas, North to Manitoba.

Poisonous properties. It is regarded with suspicion. The plant has a very disagreeable odor. A glucoside *linariin* $C_{64}H_{56}O_{40}$ has been isolated.

Veronica peregrina L. Purslane Speedwell, Neckweed

Glabrous, glandular, or nearly smooth, branching annual, 4-9 inches high;

leaves petioled, upper oblong, linear and entire; floral leaves like those of the stem but reduced; flowers axillary and solitary, white; capsule orbicular.

Distribution. A common weed in fields in eastern North America from Nova Scotia to Florida, Missouri, Kansas, Texas, British Columbia and California. Also found in Mexico, South America and in Europe, almost cosmopolitan.

Veronica virginica L. Culver's Root. Culver's Physic

A tall, smooth, or occasionally somewhat hairy perennial, simple stem; leaves lanceolate pointed in whorls finely serrate; flowers in panicled spikes, small nearly white, salverform, tube longer than the calyx; stamens 2, exserted; pistil 1, style 1; fruit a capsule, oblong-ovate.

Distribution. From western New England to Minnesota, Manitoba to Nebraska and Kansas.

Poisonous properties. The *V. peregrina* has been reported as poisonous. The root of *V. virginica* contains *leptandrin.* It is a violent emetic, cathartic, and, according to Johnson, cannot be used with safety in medicine.

3. *Digitalis* L. Foxglove

Tall herbs, leaves alternate; large purple yellowish or white flowers borne on 1-sided racemes; calyx 5-parted; corolla irregular; tube contracted, upper lip 2-cleft, lower lip 3-lobed, middle largest; stamens 4 didynamous; style slender; fruit a capsule; seeds numerous, roughened. About 20 species in Asia and Europe.

Digitalis purpurea L. Purple Foxglove

Biennial or annual pubescent herb with stout stem; lower leaves ovate or ovate-lanceolate, slender petioled, upper leaves smaller, sessile; flowers borne in long drooping racemes; corolla spotted.

Distribution. Native to Europe but widely naturalized in the Pacific Northwest.

Poisonous properties. The plant has long been used in medicine. For this purpose the leaves of the second year's growth are collected. The active constituents are such glucosides as *digitoxin,* $C_{34}H_{50}O_{10}$. The most poisonous are active, *digitalin,* $C_{35}H_{56}O_{14}$, *digitalein,* an amorphous bitter substance soluble in water, *digitonin,* $C_{27}H_{44}O_{14}+H_2O$ and *digitophyllin* $C_{32}H_{52}O_{10}$. The leaves also contain *luteolin* which occurs in mignonette.

In large doses digitalis is a gastro-intestinal irritant and in poisoning causes nausea. It causes the pulse to become slower, fuller and stronger and more regular. It causes stimulation of the heart muscles. In poisonous doses it is rapid, weak and irregular. The respiratory centers are unaffected except by toxic doses. The temperature is reduced by toxic doses. Dr. Winslow, in speaking of the cumulative action of digitalis and the toxic action, says:

> Digitalis and strychnin are said to be cumulative in their action. Evidence is stronger in the case of the former drug than in that of the latter. By cumulative action is meant sudden transition from a therapeutic to a toxic effect. This may be due to three causes. 1. Tardy absorption. 2. Increasing susceptibility. 3. Delayed elimination and accumulation of the drug in the system. The cumulative action of digitalis is chiefly due to the latter cause. It should never be administered in full medicinal doses uninterruptedly for any considerable length of time.
>
> Toxicology.—Poisoning may occur from large single doses within 3 to 10 hours of their ingestion, and last for 16 or more hours with a fatal result; or may appear suddenly after the administration for several days of large medicinal doses (cumulative action). A minimum fatal dose for the horse is about ʒ vi. of digitalis, or gr. i. ss. of Homolle's digitalin. For dogs,

ʒ i. of digitalis, or gr. ¼ of digitalin. The symptoms exhibited are chiefly concerned with the digestion and circulation. They consist in dulness, lassitude, loss of appetite, nausea, flatulence, diarrhoea, infrequent, full pulse (reduced 6-10 beats in the horse), and contracted pupils. There is vomiting in dogs. In fatal cases these symptoms are followed by severe colic and tympanites; rapid, feeble, dicrotic, irregular or intermittent pulse (120-140 in horses), while the heart may be heard and felt beating wildly and strongly, and a systolic blowing murmur can frequently be detected. This is due to mitral or tricuspid regurgitation caused by irregular contraction of the columnæ carnæ. The pulse is imperceptible because of the failure of the heart to fill the vessels. The extremities are cold, the eye is protruding, and salivation occurs. Bloody diarrhoea is very often present and the urine may be suppressed. The breathing finally becomes difficult and death ensues within a few hours, or as late as several days.

Treatment.—Evacuation of the stomach and bowels. Tannic acid, as a chemical antidote, alcohol, opium, and aconite, which is the physiological antagonist in depressing the action of the heart and lowering blood tension. In addition, external heat should be applied and complete quiet and rest secured.

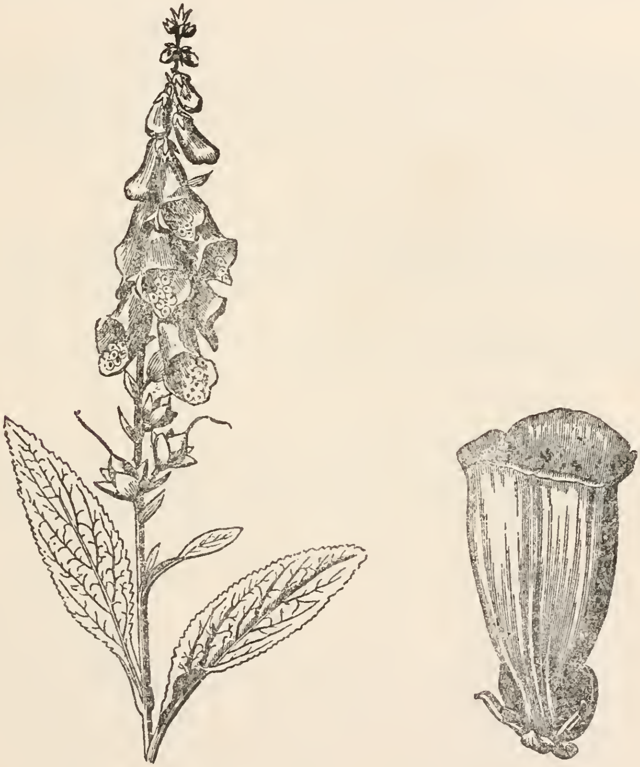

Fig. 429. *Digitalis purpurea.* Flowering branch-diminished. Flower natural size. A well known medicinal and poisonous plant. (From Vesque's Traité de Botanique).

4. *Gerardia* (Plumier) L. Gerardia

Erect herbs or a few shrubs; leaves generally opposite and sessile or the upper alternate; flowers showy purple or yellow; calyx bell-shaped, 4-toothed or 5-lobed; corolla somewhat irregular, bell-shaped, 5-lobed, slightly 2-lipped; stamens 4, somewhat unequal; filaments pubescent; capsule many seeded. About 40 species native to America.

Gerardia tenuifolia Vahl. Slender Gerardia

A glabrous annual; leaves narrowly linear acute; calyx teeth very short acute; corolla light purple spotted ½ inch long.

Distribution. In low grounds Quebec to Minnesota, Iowa, Kansas and Louisiana.

Gerardia grandiflora Benth

A common pubescent annual or biennial 2-4 feet high; leaves ovate lanceolate coarsely toothed or cut, the lower pinnatifid; pedicels shorter than the calyx; calyx-lobes oblong or ovate; corolla longer than calyx-lobes.

Distribution. In dry woods Wisconsin, Minnesota to Texas and Tennessee.

Poisonous properties. The first species said to be poisonous to sheep and calves. Other species probably poisonous.

5. *Pedicularis* (Tourn.) L. Lousewort

Perennial herbs with pinnately lobed or cleft or pinnatifid leaves; calyx tubular; corolla 2-lipped, the upper lip arched, frequently beaked at the apex; lower lip erect; stamens 4, under the upper lip, anthers transverse; capsule generally oblique; several-seeded. About 125 species mostly in the Northern Hemisphere.

Pedicularis canadensis L. Lousewort

Hairy simple stemmed plant from 6 inches-1 foot high; leaves scattered, the lowest pinnately parted; flowers in short spikes; calyx split in front, oblique; corolla greenish yellow and purple, upper lip of the corolla hooded, 2-toothed under the apex.

Distribution. In woods and prairies from eastern Canada to Florida, to Missouri and New Mexico, to Manitoba.

Pedicularis lanceolata Michx. Swamp Lousewort

An upright glabrous perennial from 1-3 feet high; leaves opposite and alternate, lanceolate or linear-lanceolate, pinnately lobed, the lower petioled; flowers in spikes; calyx 2-lobed, leafy-crested; corolla pale yellow, bearing a short truncate beak, the lower lip nearly erect; capsule ovate, about as long as the calyx.

Distribution. In swamps from Ontario to Connecticut, Virginia, Iowa, Nebraska, Minnesota to Manitoba.

Poisonous properties. P. canadensis is said to be poisonous to sheep and *P. lanceolata* is also suspected. Rocky Mountain species such as *P. groenlandica, P. racemosa* and *P. bracteosa,* are frequently eaten by sheep without any ill effects. Lehmann lists three European species as poisonous, the *P. palustris, P. sylvatica* and *P. sudetica.* A decoction made from these European plants is used to destroy animal parasites. In cattle these plants cause anemia.

Dr. Lindley, in speaking of the European species, says, "they are acrid but are eaten by goats." The European *P. palustris* was formerly officinal and is much used in Europe as a domestic remedy. The glucoside, *rhinanthin,* is found in the different species of the genus. It is identical with the material found in the common Butter and Eggs (*Linaria vulgaris*) ($C_{64}H_{56}O_{40}$).

BIGNONIACEAE. Bignonia Family

Woody plants, trees, shrubs or woody climbers or some exotic herbs; leaves opposite or rarely alternate; flowers mostly large and showy; calyx 2-

lipped, 5-cleft or entire; corolla tubular bell-shaped, 5-lobed, somewhat irregular; stamens inserted on the corolla; some of the stamens sterile or rudimentary, inserted on the tube of the corolla, anther bearing 2 or 4; ovary usually 2-celled; fruit a 2-valved capsule; seeds flat, winged; cotyledons broad and flat.

About 500 species mostly tropical. The trumpet creeper (*Tecoma radicans*), native from Pennsylvania to Minnesota and southward, produces large scarlet or orange flowers, and is much cultivated as an ornamental plant. It contains narcotic principles. *T. jasminoides,* much cultivated in greenhouses for its pretty white, pinkish or purple flowers, is a native of Brazil. *Bignonia capreolata,* from Virginia to southern Illinois and southward, produces pretty orange red flowers and is cultivated southward. *B. venusta* is a greenhouse plant native to Brazil. The leaves of Caroba (*Jacaranda procera*) furnish a valuable alterative. The *Newbouldia laevis* is used in dysentery.

Catalpa Scop. Catalpa

Trees or shrubs; leaves opposite or verticillate, simple, petioled; flower large in terminal panicles; calyx deeply 2-lipped; corolla bell-shaped with spreading margin; some stamens with fertile anthers 2, the others sterile or rudimentary; capsule large and slender, 2-celled; seeds numerous, winged. Seven species in Asia, North America and the West Indies.

Catalpa speciosa. Warder. Common Catalpa.

A large tree with thick bark; leaves large, heart-shaped, long, acuminate; corolla 2 inches long, white and mottled; capsule thick with numerous seeds.

Distribution. The common hardy catalpa (*C. speciosa*), a native to the United States from Illinois to Arkansas, is a tall tree largely planted for its wood, which is used for posts, and railroad ties. It is hardy as far north as northern Iowa.

Catalpa bignonioides Walt.

Tree with thin bark, spreading branches; leaves strongly scented and broadly ovate entire or 3-lobed acute or acuminate, deeply pubescent beneath; flowers in panicles, white mottled with yellow and purple; corolla tube, bell-shaped, the lower lobe entire; capsule rather thin walled, drooping.

Distribution. Commonly cultivated but less hardy than the preceding, native to the Gulf States.

Poisonous properties. The odor coming from the fragrant flowers is poisonous and Dr. White in his Dermatitis Venenata states that the flowers are irritating to many persons. Dr. Millspaugh, also, says that it is considered to be dangerous to inhale the odor of the flowers for a long time, which, however, is probably not generally the case. The allied caroba (*Jacaranda procera*) contains the bitter principle *carobin.* The glucoside, *catalpin,* comes from the bark and pod of *C. bignonioides.* The *Oroxylon indicum* contains *oroxylin* $C_{19}H_{14}O_6(OH)_3$.

PLANTAGINALES

This order contains but one family, the *Plantaginaceae.*

PLANTAGINACEAE Lindl. Plantain Family.

Mostly stemless herbs; leaves, in species with stems, opposite or alternate; flowers small, perfect, polygamous or monoecious; calyx 4-parted, persistent;

corolla 4-lobed, hypogynous; stamens 4 or 2 or only 1, inserted on the throat or tube of the corolla; ovary 1-2 celled, or falsely 3-4-celled, sessile; ovule 1, several ovules in each cavity; fruit a pyxis, circumscissile, at or below the middle or a nutlet.

3 genera, 2 native to North America, and more than 200 species, of wide distribution. None of the plants are of any economic importance. The seeds of several species (*Plantago major* and *Plantago Rugelii*) are used to feed birds. The *P. ovata* is used in France as a salad. The seeds of *P. arenaria* of Europe and *P. indica* are used for sizing in the manufacture of muslin. All of the seeds of the genus have a mucilaginous testa.

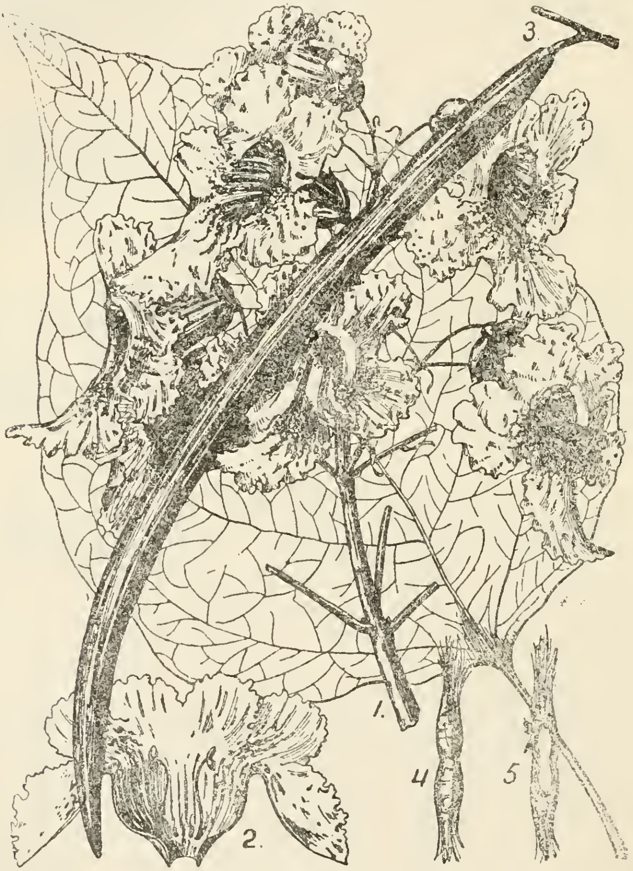

Fig. 430. Hardy Catalpa (*Catalpa speciosa*). 1, Panicle of flowers. 2, Longitudinal section of flower. 3, Single fruit. 4, Seed. 5, Longituinal section of seed. All one-half natural size. (M. M. Cheney in Green's Forestry in Minnesota).

RUBIALES

Leaves opposite or whorled; flowers with gamopetalous corolla, separate anthers; stamens as many as the lobes of the corolla and alternate with them or occasionally fewer or twice as many; ovary compound, adnate to the calyx tube; ovules one or two in each cavity of the ovary. The important families are *Rubiaceae,* containing cinchona coffee, asperula, and galium; Adoxaceae containing a single genus *Adoxa* the Musk-root, *A. Moschatellina; Valerianaceae* containing the corn salad (*Valerianella olitoria,* and *Valeriana officinalis*), native to Europe and North America, the roots of which are used in medicine; *Dipsaceae,* containing fuller's teasel (*Dipsacus fullonum*), whose rigid chaff hooked at the end is used for carding woolen cloth, and scabious (*Scabiosa maritima*) frequently cultivated for ornamental purposes; and *Caprifoliaceae.*

Families of *Rubialcs*

Herbs or shrubs; flowers regular; leaves with stipules.	Rubiaceae.
Herbs or shrubs; flowers regular or irregular; leaves without stipules.	Caprifoliaceae.

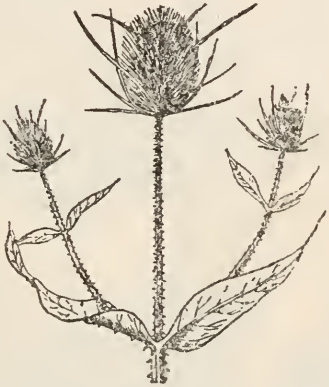

Fig. 431. Teasel (*Dipsacus sylvestris*). A common American weed allied to Fuller's Teasel. (Millspaugh-Selby).

RUBIACEAE B. Juss. Madder Family.

Herbs, shrubs or trees, with simple opposite leaves connected by stipules, or the leaves sometimes in whorls without stipules; calyx tube adnate to the ovary; flowers regular and perfect, often dimorphic; corolla funnel-shaped, club-shaped, bell-shaped or rotate, 4-5 lobed; stamens as many as the lobes of the corolla and alternate with them; pistil with a simple or lobed style; ovary 1-10 celled; ovules one to many in a large cell; fruit various, capsule, berry or drupe; seeds small or large, the coat thin or hard; endosperm fleshy or horny.

A large order, chiefly tropical, consisting of about 350 genera and 5000 species. Only a few of them found in northern United States. Some species are abundant in southern United States, a few being weedy. Cinchona or Peruvian Bark, from which quinine is derived, is found in several species of the genus Cinchona, a tree with evergreen leaves. Quinine is derived chiefly from *Chincona officinalis,* which is a native of South America; *C. lancifolia* is native to Peru. The Cinchona is now, however, extensively cultivated in India. Its use in fevers has been recognized since its earliest introduction from the wild plants gathered in the Andes Mountains by the Indians. The Red cinchona is obtained from *C. succirubra* and Calisaya bark from *C. Ledgeriana.*

Cinchona contains a large number of alkaloids of which the following are more important: *Cinchonin*, $C_{19}H_{22}N_2O$, *quinamin*, $C_{19}H_{24}N_2O_2$, *quinin*, $C_{20}H_{24}N_2O_2$, *hydroquinin*, $C_{20}H_{26}N_2O_2$, *aricin*, $C_{23}H_{26}N_2O_4$. Another alkaloid belonging to this group is *disinchonin*, $C_{23}H_{44}N_4O_2$. *Javanin*, $C_{23}H_{26}N_2O_4$, occurs in Calisaya bark. The Cuprea bark (*Remijia pedunculata*) from the U.S. of Colombia is also used in the manufacture of quinine and contains *cinchonanin*, $C_{19}H_{24}N_2O$. The partridge berry (*Mitchella repens*) is a tonic. Gambier (*Uncaria*) of the East Indies is used for tanning. The root of ipecac (*Psychotria Ipecacuanha*) of Brazil is a systemic emetic used as a remedy in dysentery and contains *emetin*, $C_{15}H_{22}N_2O_5$ and *cephaëlin*, $C_{14}H_{20}NO_2$. Madder (*Rubia tinctorum*) of the Levant and Southern Europe is used for dyeing and contains a red coloring matter, *alizarin*. The *Morinda citrifolia* contains a yellow coloring principle *morindin*. The cape jasmine (*Gardenia jasminoides*) also contains a yellow coloring resembling crocin.

Coffee obtained from the *Coffea arabica* and other species, contains the chemical principle *caffein* $C_8H_{10}N_4O_2$. This is the same as *thein*. This substance occurs in a large number of plants including cocoa (*Theobroma Cacao*), cola (*Cola acuminata*), yopan (*Ilex Cassine*), maté (*I. paraguensis*), *Sterculia platanifolia*, *Paullinia Cupana*.

Green seeds of *Coffee arabica* contain 1.22 per cent of *caffein* or *thein* $C_8H_{10}N_4O_2$, the young leaves of Chinese tea 2.12 per cent. *Caffeidin* $C_7H_{12}N_4O$ is obtained from caffein. Caffein causes the heart to beat more forcibly; it is a cerebral stimulant, producing wakefulness and restlessness; in lower animals it produces excitement and mania. From a toxicological point it is a spinal and muscle poison to the frog. In dogs and mammals it causes restlessness, and in dogs it produces vomiting. The minimum fatal dose according to Winslow is 1 gr. to 1 lb. of live weight.

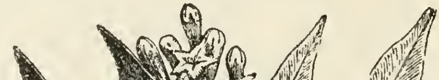

Fig. 432. Cinchona (*Chinchona lancifolia*). A native of Peru and one of the species furnishing the Peruvian bark of commerce. (From Strasburger, Noll, Schenck and Schimper).

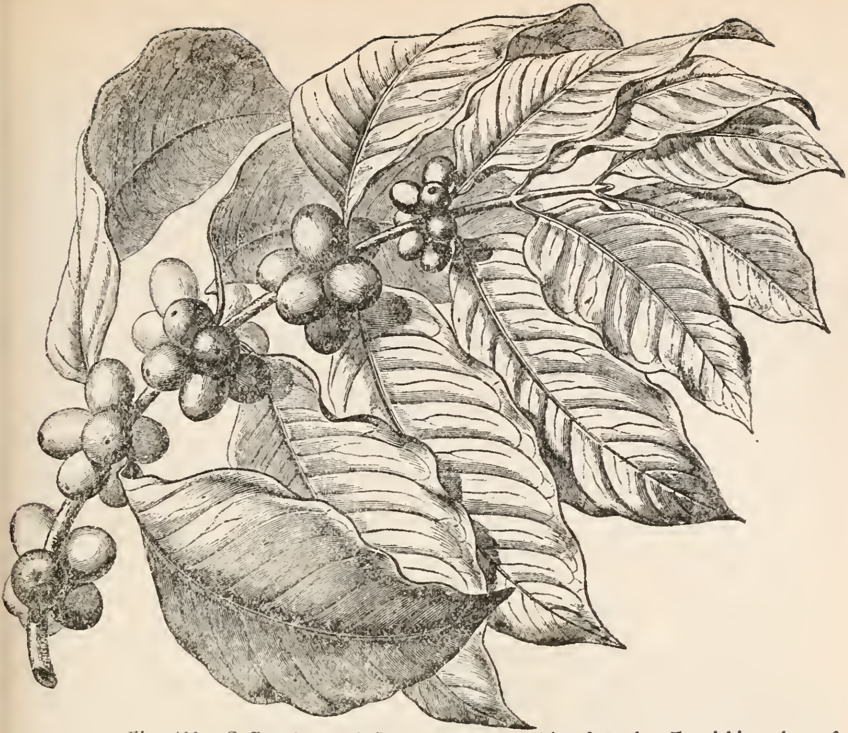

Fig. 433. Coffee-plant (*Coffea arabica*). Fruiting branch. Furnishing the coffee berry of commerce. (After Faguet).

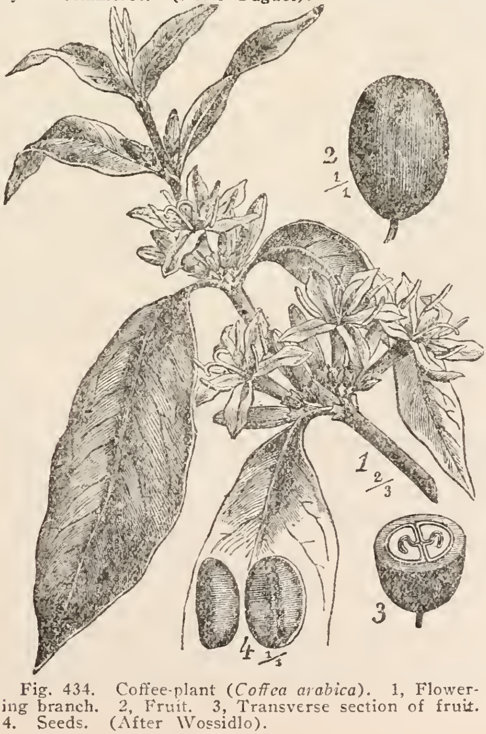

Fig. 434. Coffee-plant (*Coffea arabica*). 1, Flowering branch. 2, Fruit. 3, Transverse section of fruit. 4. Seeds. (After Wossidlo).

The coffee plant is a small evergreen tree native to the tropical mountain districts of Africa but now cultivated in all warm countries. It was introduced into Arabia early in the 15th century or perhaps earlier. Brazil supplies a large amount of coffee. Large amounts of coffee also come from Ceylon, Java and the Celebes. It is also grown in Puerto Rico and Cuba. Its first introduction is said to have occurred in the middle of the 16th century. The Mocha coffee comes from southwestern Arabia.

The sweet-scented bedstraw (*Galium triflorum*) is used in making an aromatic drink, especially in German communities in this country. It contains *coumarin*. In Europe the sweet woodruff (*Asperula odorata*) is used like *G. triflorum* and when added to wine, the drink is known as "Mai-trunk."

Cephalanthus L. Button Bush

Shrubs or small trees; leaves opposite or verticillate; flowers in spherical peduncled heads, white or yellow; calyx tube obpyramidal with 4 obtuse lobes; corolla tubular 4-toothed; stamens 4, inserted on the throat of the corolla; ovary 2-celled ,ovules solitary in each cavity; style thread-like, stigma capitate; fruit dry obpyramidal 1-2 seeded.

About 7 species native to America and Asia.

Cephalanthus occidentalis L. Button Bush

A shrub or small tree; leaves petioled ovate or lanceolate-oblong pointed, opposite or whorled with small petioles; flowers borne in globular head; sessile white; style longer than the corolla.

Distribution. In swamps and low grounds from Canada to Minnesota, Texas and Florida.

Poisonous properties. The leaves contain a poisonous, bitter glucoside *cephalanthin* $C_{22}H_{34}O_6$. It has been used in medicine on account of its bitter properties.

CAPRIFOLIACEAE Vent. Honeysuckle Family.

Shrubs, trees or vines, or rarely herbs, with opposite leaves; stipules absent or present; flowers perfect, mostly cymose; calyx adnate to the ovary, 3-5 toothed or 3-5 lobed; the gamopetalous corolla with a 5-lobed limb or 2-lipped; stamens 4-5, inserted on the tube of the corolla and alternate with its lobes; ovary 2-5 celled; style slender; stigma capitate; fruit a berry, drupe or pod; seeds with a membranous or hard coat.

About 275 species. Generally found in the northern hemisphere. The plants of this order are of small economic importance. Several are used in medicine, as the feverwort (*Triosteum perfoliatum*).

Many members of the order are used for ornamental purposes. The most important are members of the genus *Lonicera*. Of the native species, the trumpet honeysuckle (*Lonicera sempervirens*) is widely cultivated, also Sullivant's honeysuckle (*L. Sullivantii*), Fraser's honeysuckle, (*L. flava*), and the western honeysuckle (*L. involucrata*). Some of the Loniceras are possibly poisonous. Of the European and Asiatic species, the *L. tatarica, L. japonica, L. fragrantissima* and *L. Periclymenum* are cultivated. The elders (*Sambucus canadensis* and *S. racemosa*) are likewise cultivated in the North. The former is often weedy. Several species of the snowberries, like the wolfberry (*Symphoricarpos occidentalis*) and the snowberry proper (*S. racemosus*) are native to the northern states. The Indian currant (*S. orbiculatus*) is sometimes weedy in Iowa and Missouri. Suckers used in Arkansas for making baskets. The *Linnaea borealis* or twin-flower is native in the cool damp woods of the North.

Several of the viburnums are cultivated. The hobblebush (*V. alnifolium*), a native from Ontario and southward, is frequently cultivated in the East. The cranberry-tree or guelder rose (*V. Opulus*) found along streams from New Brunswick to northeastern Iowa, is cultivated both in its native and cultivated forms. The well-known snowball is a cultivated form of the cranberry tree. The fruit of this plant is used in the North. The root of horse gentian (*Triosteum perfoliatum*) has a bitter taste and is used as a cathartic. The flowers of the elder berry (*Sambucus canadensis*) are sudorific. The bark of *Viburnum prunifolium*, the black haw, is officinal, an antispasmodic, nervine and an astringent. It is also used as an uterine sedative, contains *viburnin, oxalic acid, tannic acid*, etc. The bark of *V. Opulus* is said to be antispasmodic. *Xylostein* occurs in *Lonicera Xylosteum*. According to Greshoff the leaf of *Viburnum macrophyllum* and of *Symphoricarpos mollis* contain saponin.

Genera of *Caprifoliaceae*

Flowers in compound cymes; corolla rotate..........................Sambucus
Flowers not in cymes, tubular to campanulate.
Erect perennial herbs..Triosteum.
Shrubs ....Symphoricarpos.

Triosteum L. Horse Gentian. Feverwort

Coarse hairy perennial herbs with simple stems; leaves connate perfoliate or sessile; flowers axillary perfect sessile; calyx tube ovoid with a 5-lobed limb, persistent; corolla tubular, gibbous at the base, 5-lobed; stamens 5, anthers linear; ovary 3-5 celled; ovule 1 in each cavity; style filiform; fruit a dry drupe orange or red, enclosing 2-3 or rarely more 1 seeded nutlets, embryo minute.

Triosteum perfoliatum L. Feverwort. Wild Coffee

A soft hairy perennial 2-4 feet high; leaves oval, abruptly narrowed below, downy beneath; flowers brownish purple, clustered; corolla purplish; fruit orange in color.

Distribution. In rich woods New York to Minnesota, Kansas and Alabama.

Poisonous properties. Some species of the genus were used by the Indians as a cure of fevers and early practitioners in this country used the root as an emetic. In early days, the berries of this plant were used as a substitute for coffee. The physiological action of the plant is to produce vomiting. It has a bitter nauseous taste.

Sambucus (Tourn.) L. Elder

Shrubs, trees or occasionally herbs; leaves opposite, pinnate; flowers small in compound cymes; calyx-lobes minute or obsolete; corolla rotate or somewhat campanulate, regular with a 5-cleft wing; stamens 5, inserted at the base of the corolla; stigmas 3; ovary 3-5-celled; ovules 1 in each cavity; fruit a berry-like drupe with 3-5 1-seeded nutlets; endosperm fleshy.

About 20 species of wide distribution.

Sambucus canadensis L. Common Elder

A shrub from 5-10 feet high, wood with large lenticels and large pith; leaflets 5-11 ovate or oval acuminate or acute, short stalked, smooth above, sharply serrate; flowers white.

Distribution. From Canada to Manitoba, Kansas, Texas to Florida.

Poisonous properties. In regard to the poisonous properties Dr. Rusby says:

> The common black elder or *Sambucus canadensis* L., a plant very common throughout the entire eastern and central United States, and represented by other species, apparently with similar properties, upon the Pacific Coast and in the old world, has dangerous properties which have remained unrecognized, or, to say the least, very obscure, to the present time.

Of the last mentioned, Dr. Robert Christian reports in the Edinburgh Medical and Surgical Journal, 1830, page 73, as follows:

> Two boys in the vicinity of Edinburg encountered a clump of the S. Ebulus, and one of them ate freely of the flowers, the other of the leaves. The boy who had eaten the leaves was attacked with enteritis, the abdomen at length becoming so sore that it could scarcely be touched. There was continuous vomiting, the matter containing blood. Obstinate constipation existed throughout. The boy was saved by vigorous treatment. The one who had eaten the flowers suffered considerably, and for a considerable time, from vertigo with some headache, but the symptoms were not very serious.

Dr. Christian observed that both the berries and the flowers were known to kill fowls which fed upon them and that when berries were freely eaten they often caused giddiness. He also quotes a report of a case of a woman who dressed the shoots with vinegar and ate them as a salad, and who was promptly seized with violent purging, forty times in two days, coma resulting on the third day. Of our own species, *S. canadensis*, Dr. Johnson states that the bark and the root are actively cathartic and hydragogue when freely used.. There is little doubt that he refers in this instance to the bark and the root in the green condition, since it is well-known that the properties become much less active upon drying and keeping.

> Our most direct evidence bearing upon the poisonous character of the elder-berry root rests upon a case which occurred in the spring of 1894, at the Institution of Mercy, a Roman Catholic institution for children at Tarrytown, on the Hudson, and which attracted a great deal of attention at the time in the public press. The grounds of this institution were comparatively new, and ditching and fencing were still in progress at the time stated. A workman in digging a drain, uncovered a large number of roots to which the children took a fancy and which they began eating. Within a very few minutes, and while still engaged in eating, a large number of the boys were seized with convulsions and several of them died. One of them had the remainder of the root, the marks of his teeth upon it, still clutched in his hand after death. The symptoms correspond in most features to those of the Cicuta poisoning above described and to that agent the accident was ascribed in the public press. Several months later I visited the institution in company with Mr. Frederick V. Coville, the botanist of the United States Department of Agriculture and Prof. Edward L. Greene, Professor of Botany, in the Catholic University at Washington. At this time, and subsequently through correspondence, a pretty thorough investigation of the case was made. We found that it was not a locality where Cicuta would be apt to grow and no evidence existed that any had grown there. Three poisonous plants grew upon the spot, viz., the locust, poke-berry and elder. The workman who had dug the drain, the surviving boys and the Sisters in attendance were positive that it was the elder root which had occasioned the poisoning. They did not know the name of the plant, and had accepted the statements of the papers that it was Cicuta; but they positively identified it by its appearance and by the young purple shoots and compound leaves which they had observed carefully while still attached to the pieces of root which had been taken from the hands of the boys poisoned. Their story was so clear, connected and positive that it was difficult to doubt that the elder root was the poisoning agent. Furthermore the locust would not have produced the symptoms that were observed. and the poke should have at once been distinguished by even a casual observer. Nevertheless, since the root was described as "like a carrot or parsnip," and since the symptoms in some respects resembled those of Pokeroot poisoning, the question cannot be regarded as settled beyond a doubt. In the case of so large a number of victims it is even possible that both of the roots were concerned. The attending physician, Dr. Luke Fleming, does not believe that the poisoning was caused by Elder. The active constituent of the elder is not known farther than that a report has isolated coniin from the twigs and leaves of the related European species, *S. nigra*. This would, of course, explain the very similar symptoms to those of Cicuta poisoning. The chemistry of the plant is now receiving thorough investigation in the division of pharmacology in the United States Department of Agriculture.

In Part I attention was called to Treub's theory in regard to the role of hydrocyanic acid in plants. Prof. Treub in a recent paper[1] reiterates his former conclusions that it performs some part in the products of assimilation. It was found that the amount of hydrocyanic acid in plants of Sorghum increases during the day because of its relation to the products of assimilation of carbon. It had previously been shown in the case of *Pangium edule* and *Phaseolus lunatus* that light plays no part in the formation of this substance, except as it favors photosynthesis. The same results have now been obtained with *Prunus javanica, Passiflora foetida,* and some other plants. The results of the investigation with these plants show a direct proportion between the formulation of hydrocyanic acid and the function of the chlorophyll. The amount of acid is usually greatest in the young leaves and gradually diminishes as the leaves grow older. Leaves about to fall contain very little hydrocyanic acid. *Sambucus nigra,* according to Guignard is one of the exceptions to the rule, and Treub has also found this to be true for *Indigofera galegoides.* Hydrocyanic acid is probably the first recognizable product of the assimilation of nitrogen "and perhaps the first organic nitrogen compound formed." The amounts of the acid in the plants could be increased and decreased in proportion to the amount of nitrate used. Ravenna and Peli think that the nitrates are necessary for the formation of the acid. Treub agrees with this and adds that dextrose is especially essential. The acid probably occurs in the form of a glucoside and is liberated by an enzyme or by boiling water.

The investigations of Em. Bourquelot and Em. Danjon[2] with the glucosides found in various plants show that they are not identical. In *Sambucus nigra* they find *sambunigrin.* They also studied the character of glucosides from which hydrocyanic acid is derived in *S. racemosa* and *S. Ebulus.*

The flowers have long been used in domestic practice. The physiological action recorded for the drug by Dr. Millspaugh are as follows:

> Dr. Ubelacker's experiments with from 20 to 50 drops of the tincture gave the following symptoms of physical disturbance: Drawing in the head, with anxious dread; flushed and blotched face; dryness and sensation of swelling of the mucous membranes of the mouth, pharynx, and trachia; frequent and profuse flow of clear urine; heaviness and constriction of the chest; palpitation of the heart; pulse rose to 100, and remained until perspiration ensues; sharp, darting rheumatic pains in the hands and feet; exhaustion and profuse perspiration, which relieved all the symptoms.

Prof. Hyams states that the young buds of the American elder are especially poisonous.

The European *Sambucus nigra* contains the alkaloid *sambucin;* according to Sanctis the same plant contains *coniin. Sambunigrin* has also been isolated and hydrocyanic acid is known to be present.

Symphoricarpos (Dill.) Ludwig. Snowberry

Low, branching shrubs; leaves oval, short petioled entire or wavy-toothed, downy underneath; flowers white tinged with purple; calyx-tube nearly globular, teeth short; corolla bell-shaped 4-5 lobed; stamens 4-5 inserted in corolla; ovary 4-celled, 2 with a fertile ovule; fruit a berry 4-celled and 2-seeded; embryo minute.

About 10 species of North America. One species frequently cultivated for ornamental purposes. The wolf-berry (*S. occidentalis*) northward is common in the Rocky Mountains and frequently cultivated. The snowberry (*S. racemosus*) is common in rocky woods, and abundant along river course from Minnesota to Arkansas and westward.

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[1] Nouvelles recherches. Ann. Jard. Bot. Buitenzorg. II. 8:84-118. 1910. See R. Catlin Rose, Bot. Gazette 50:156.

[2] Soc. Biol. Paris. 7. July, 1905. 1. c. Oct. 9, 1905. Jour. de Pharm. et de Chimie, Aug. 16, and Sept. 1, 1905. Compt. rend. Acad. Sci. Paris, July 3, 1905.

Symphoricarpos orbiculatus Moench. Indian Currant. Coralberry

A shrub 2-4 feet high, purplish, usually pubescent, branches; leaves oval or ovate entire or undulate, nearly glabrous above, pubescent underneath; flowers in short axillary clusters; corolla bell-shaped sparingly bearded, pinkish, stamens included; fruit a purplish berry.

Distribution. Rocky woods and along streams; from New Jersey, Illinois, Southern Iowa, South Dakota, Nebraska, Texas to Georgia.

Poisonous properties. It is suspected of being poisonous, but there is no direct evidence to support this view.

CAMPANULATAE

Herbs or rarely shrubs; corolla gamopetalous; petals occasionally separate; stamens as many as the lobes of the corolla; anthers united; ovary inferior. It contains the families *Cucurbitaceae, Candolleaceae* (mostly Australian), and *Compositae,* this last order including *Cichoriaceae, Compositae* and *Ambrosiaceae* of some authors.

Families of *Campanulatae*

Herbs or rarely shrubs; flowers in an involucrate bead............Compositae.
Flowers not in involucrate heads.
    Flowers monoecious or dioecious, generally vines...........Cucurbitaceae.
    Flowers perfect ....Lobeliaceae.

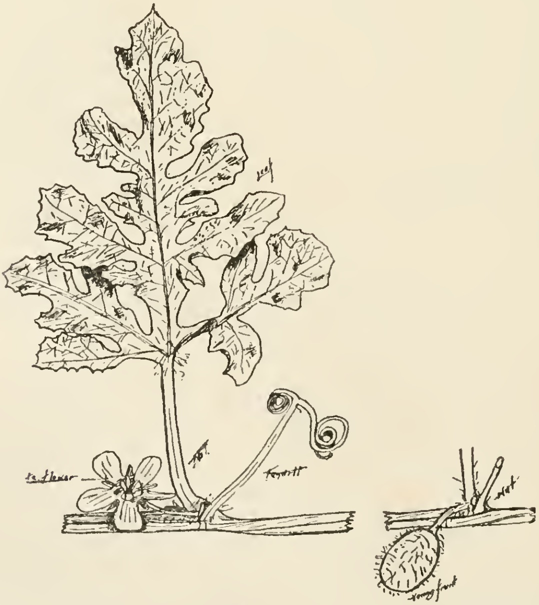

Fig. 435. Water melon (*Citrullus vulgaris*). (W. S. Dudgeon).

CUCURBITACEAE B. Juss. Gourd Family

Herbaceous vines, usually with tendrils; leaves alternate, petioled, palmately lobed or dissected; flowers dioecious, monoecious or rarely perfect; calyx tube adnate to the ovary, 5-lobed; petals usually 5, inserted on the limb of the calyx; stamens 1-3, 2 of them with 2-celled anthers, the other with a 1-celled anther; filaments short, frequently monadelphous; ovary 1-3-celled; stigmas 2 or 3; fruit indehiscent or rarely dehiscent; seeds flat in the large embryo, exalbuminous.

About 650 species, mainly in tropical regions. A few of the species are medicinal. The squirting cucumber (*Ecballium Elaterium*) is a fleshy decumbent herb used for making elaterium, a powerful hydragogue cathartic and an irritant poison. Its poisonous nature was known to Pliny. It contains *elaterin,* $C_{20}H_{28}O_5$. *E. officinale* contains *prophetin,* another glucoside. The colocynth (*Citrullus Colocynthis*) a slender scabrous plant with perennial roots, is native to the dry regions of the Old World, Palestine and North Africa. Its gourd is about the size of an orange and used as a purgative, while the seeds are roasted and boiled and used as food by some of the tribes of the Saharah. Tea made from this fruit is used by the people of the Nile to smear their water bags to prevent camels from cutting them. It contains *colocynthin,*

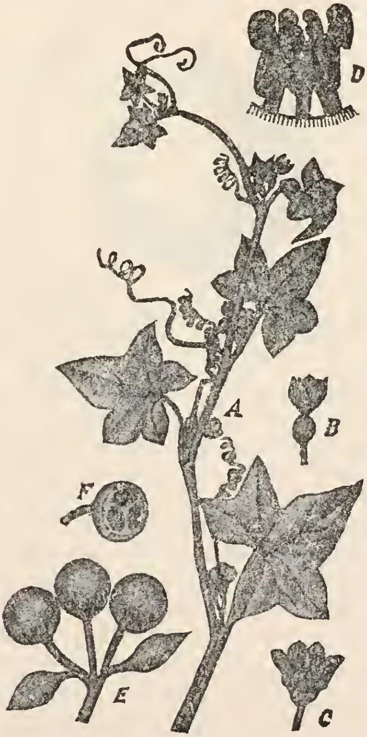

Fig. 436. Bryony (*Bryonia dioica*). A a branch with flowers; b, female flowers; c, male flowers; d, stamens; e, fruits; f, section of fruit. (After Strasburger, Noll, Schenck and Schimper).

$C_{98}H_{140}O_{43}$. The plant is intensely bitter. The towel or sponge gourd (*Luffa aegyptiaca*), a native of Egypt, produces a fruit one foot or more long, filled with a spongy fiber, which when the outer part is removed is used to rub the skin, and for many other domestic purposes. The fruits of many plants of the family are economic. The nara (*Acanthosicyos horrida*) in Southern Angola is used as food and has medicinal virtues. The chayote (*Sechium edule*) is cultivated in the West Indies for its fruit. The green and ripe fruit of the cucumber (*Cucumis sativus*) native to India, has long been used for food, especially for pickles, and the West Indian gherkin (*C. Anguria*) is also cultivated for the same purpose. According to Greshoff the foliage of *Cucumis metuliferus* contains saponin. He also states that he found saponin in the seeds of *Lagenaria vulgaris*, and *Cucurbita maxima*. The *C. myriocarpus* contains the toxic alkaloid *myriocarpin*. The musk melon (*Cucumis Melo*), a native to British India, is now widely cultivated. Sugar and nutmeg melons are well known everywhere in North America. The water melon (*Citrullus vulgaris*), native to tropical Africa, where large areas of wild plants occur, has long been cultivated in Mediterranean countries, and is well known everywhere in North and South America. The citron is a form of the water melon. The common pumpkin (*Cucurbita Pepo*) is native to southwestern North America, Arizona and Mexico. It is used for stock food and for culinary purposes. The nest-egg gourd, bush scalloped squash, crookneck squash and common pumpkin are all from the same species. The seeds of pumpkin and squash are used in North Africa and Egypt much as peanuts are in this country and have taenifuge properties. The winter squash (*C. maxima*) is probably also of

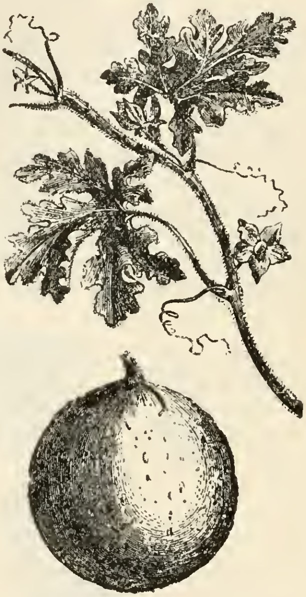

Fig. 437. Colocynth (*Citrullus colocynthis*). An intensely bitter plant of economic importance. (After Faguet).

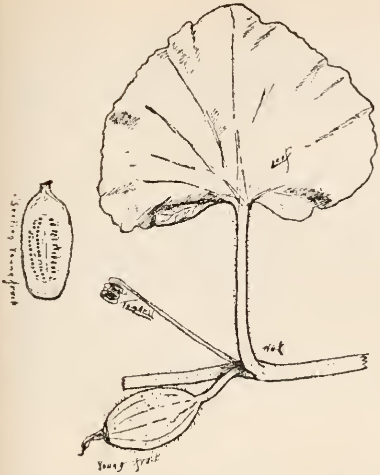

Fig. 438. Muskmelon (*Cucumis Melo*). A part of a plant of the common melon. (W. S. Dudgeon).

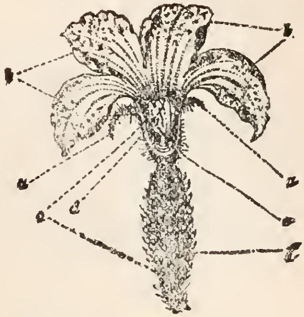

Fig. 439. Pistillate flower of cucumber (*Cucumis*). a, sepal; b, petal; c, pistil; d, stigma; e, style; f, ovary. (Pieters, U. S. Dept. Agr.).

American origin. The hubbard squash is a well known representative of the species and is used in various food preparations. Other species like cushaw (*C. moschata*) are also cultivated. The Missouri gourd (*C. foetidissima*), with a large root, sometimes a foot in diameter, occurs from Nebraska to Texas. The wild cucumber or wild balsam apple (*Echinocystis lobata*) is frequently used as a climber and is sometimes weedy. The star cucumber (*Sicyos angulatus*) is used in a similar way. The cocoon antidote, (*Fevillea cordifolia*), a native of Jamaica, has seeds which are used as a cure for snake bites and as an antidote against *Entada scandens*. They also contain an oil. The seeds of *Tefaria pedata*, a native of the East coast of Africa and Zanzibar, contain an excellent oil. The bryony of Europe (*Bryonia dioica*) is a climbing plant producing a pretty colored fruit. It is a drastic purgative and is poisonous. It contains the alkaloid *bryonicin* $C_{10}H_{17}NO_2$, and the root of *Bryonia alba* contains the glucoside *bryonin* $C_{62}H_{93}O_{31}$. Dr. Halsted states that a friend of his has been repeatedly poisoned by handling the star cucumber (*Sicyos angulata*). Friedberger and Fröhner state that poisoning has occurred from *Cucurbita Pepo*, causing symptoms of dullness and in some cases the animals showed excitement. Major Kirtikar says that the pulp of a cucurbitaceous plant of India, *Trichosanthes palmata*, a perennial herb, is used in India to poison cattle, and that the *T. cucumerina* also of that country is an emetic and a drastic purgative. *Echinocystis macrocarpa*, according to Trimble and Sayre contains a glucoside. The marimbo or dipper gourd (*Lagenaria vulgaris*) yields gourds which are edible when small.

LOBELIACEAE. Lobelia Family

Herbs with acrid milky juice; leaves alternate; flowers perfect, irregular, 5-lobed; gamopetalous corolla; stamens 5, free from the corolla, united into a tube; stamens monadelphous and syngenesious; flowers proterandrous, the stigma of the single style often fringed with hairs; fruit a capsule with numerous small seeds; embryo minute and straight.

About 600 species of wide distribution, comparatively few in northern United States. Some of the tropical species shrubby. Several species are medicinal, among them Indian tobacco (*Lobelia inflata*). The *Lobelia erinus* of the Cape of Good Hope is frequently cultivated in the conservatories and in gardens. It has small azure blue flowers. It has escaped on the Pacific Coast.

Lobelia (Plummer) L. Lobelia

Herbs or occasionally shrubs with alternate or radical leaves; flowers racemose or spicate; calyx 5-cleft with a short tube; corolla irregular, with a straight tube split down on one side, the upper lip of 2 erect lobes, the lower lip spreading and 3 cleft; stamens 5, free from the corolla tube, monadelphous; two of the anthers or all of them bearded at the top; ovary 2-celled; fruit a 2-celled pod, many-seeded.

About 200 species, of wide distribution. Some 25 species native to the United States.

Lobelia inflata L. Indian tobacco

A pubescent or hirsute, much branched annual from 1-2 feet high; leaves dentate or denticulate, the lower larger, the upper small, bract-like, but longer than the pedicels of the flower; flowers pale blue; calyx tube ovoid; capsule ovoid, inflated.

Distribution. In fields, especially clay soils, from Labrador to Georgia, Tennessee, Arkansas, Kansas, Iowa to Northwest Territory.

Poisonous properties. It is used medicinally for laryngitis and spasmodic asthma. In full doses it produces nausea, vomiting and great prostration; in overdoses it produces prostration, stupor, coma, convulsions and death.

We quote from Dr. Millspaugh in regard to poisoning:

> Thanks to much reckless prescribing by many so-called Botanic physicians, and to murderous intent; as well as to experimentation and careful provings, the action of this drug is pretty thoroughly known. Lobelia in large doses is a decided narcotic poison, producing effects on animals generally, bearing great similitude to somewhat smaller doses of tobacco, and ***lobelina*** in like manner to *nicotia.* Its principal sphere of action seems to be upon the pneumogastric nerve, and it is to the organs supplied by this nerve that its toxic symptoms are mainly due, and its "physiological" cures of pertussis, spasmodic asthma, croup and gastralgia gained. Its second action in importance is that of causing general muscular relaxation, and under this it records its cures of strangulated hernia (by enemata), tetanic spasms, convulsions, hysteria, and mayhap, hydrophobia. Its third action is upon mucous surfaces and secretory glands, increasing their secretions.
>
> The prominent symptoms of its action are: great dejection, exhaustion, and mental depression, even to insensibility and loss of consciousness; nausea and vertigo; contraction of the pupil; profuse clammy salivation; dryness and prickling in the throat; pressure in the œsophagus with a sensation of vermicular motion, most strongly, however, in the larynx and epigastrium; sensation as of a lump in the throat; incessant and violent nausea, with pain, heat, and oppression of the respiratory tract; vomiting, followed by great prostration; violent and painful cardiac constriction; griping and drawing abdominal pains; increased urine, easily decomposing and depositing much uric acid; violent racking paroxysmal cough with ropy expectoration; small irregular slow pulse; general weakness and oppression, more marked in the thorax; violent spasmodic pains, with paralytic feeling, especially in the left arm; weariness of the limbs, with cramps in the gastrocnemi; and sensation of chill and fever. Death is usually preceded by insensibility and convulsions.

It contains *lobelic acid, lobelacrin, inflatin* and the alkaloid *lobelin* $C_{12}H_{23}NO_2$ has been isolated which according to Lloyd is a powerful emetic. *Lobelia nicotianaefolia* of India and *L. purpurascens* contain the same alkaloids. According to the late Baron Ferdinand von Müller the *L. Breynii* of Australia and other species are poisonous.

Lobelia siphilitica L. Great Lobelia

A somewhat hairy stout, perennial herb from 1-3 feet high; leaves thin, acute or acuminate at the apex, dentate or crenate-dentate, sessile or the lower petioled; flowers large, spicate, racemose, leafy bracts; calyx hirsute; corolla bright blue or occasionally white.

Distribution. In moist soil near springs and in marshes from New England to South Dakota, Kansas, Louisiana and Georgia.

Poisonous properties. It is suspected of being poisonous. Johnson in his manual says of the action of the species of Lobelia:

> In full doses lobelia produces severe nausea, obstinate vomiting, and great prostration. In overdoses the prostration becomes extreme, there is failure of voluntary motion, followed by stupor, coma, and not infrequently convulsions and death. Though formerly much used for emetic effect by empirics, dangerous effects were so often produced that it is now seldom employed in this manner. It is chiefly employed in spasmodic affections of the air-passages, as spasmodic laryngitis and spasmodic asthma. In the latter disease it often produces the happiest effects.

The great lobelia is probably not as poisonous as *L. inflata* to which the above remarks chiefly apply.

Lobelia cardinalis L. Cardinal-flower

A tall smooth or slightly pubescent perennial 2-4 feet high; leaves thin, oblong, lanceolate, smooth or slightly pubescent, crenulate; flowers racemose, bright scarlet or red.

Distribution. In moist soil, usually alluvial bottoms, from New Brunswick to Manitoba, Kansas, Texas, to Florida.

Poisonous properties. Reported as poisonous.

Lobelia spicata Lam. Spiked Lobelia

A perennial or biennial, smooth or pubescent herb; leaves smooth or minutely pubescent; leaves thickish, the lower obovate or spatulate, the upper linear or club-shaped bracts, entire or dentate or crenulate; flowers in a racemose spike, pale blue; calyx tube short, obconical or nearly hemispherical.

Distribution. Prairies or dry sandy soil. From Nova Scotia to Manitoba, Louisiana to North Carolina.

Poisonous properties. Reported as poisonous.

COMPOSITAE Adans. Thistle Family

Herbs or rarely shrubs; flowers borne in a close head on the receptacle, surrounded by an involucre of a few or many bracts; anthers usually united into a tube, syngenesious, sometimes caudate; calyx adnate to the ovary; limb crowning the summit in the form of capillary or plumose bristles or chaff called the pappus; corolla tubular or strap-shaped, when tubular, usually 5-lobed; ligulate or bilabiate in one small division of the family; the flowers of a head may be all alike when they are called homogamous; or of two kinds, heterogamous; bracts or scales on the receptacle are often present; flowers inside of the rays are disk flowers and a flower without rays is said to be discoid; stamens 5 or rarely 4; style 2-cleft at the apex or in sterile flowers usually entire; fruit a dry, indehiscent achenium containing a single seed without endosperm.

A large family consisting of 840 genera and 13,000 species, found in all parts of the world. This is the largest order of flowering plants. Sometimes it is divided into the families *Cichoriaceae, Ambrosiaceae* and *Compositae.*

A few of the plants of the family are medicinal. Inulin is obtained from

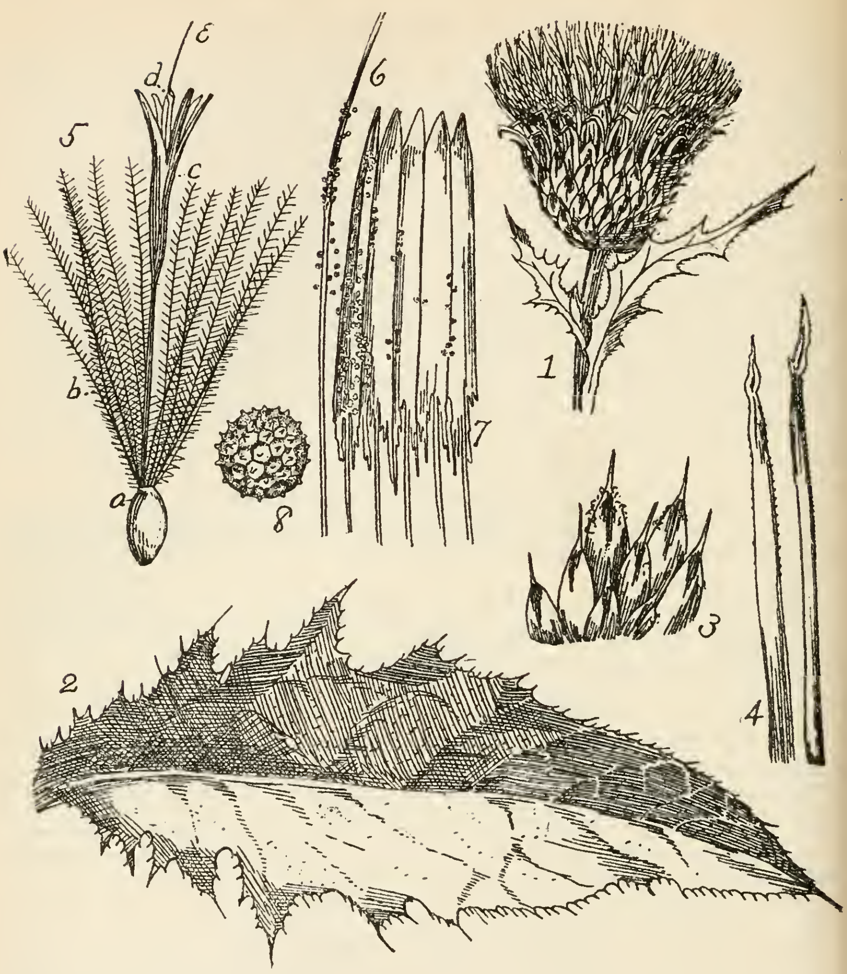

Fig. 439a. Illustrating structure of Compositae. Thistle (*Cirsium altissimum*). 1, head; 2, leaf; 3, outer bracts of head; 4, inner bracts; 5, single flower; a, achene; b, pappus; c, tubular corolla with 5 lobes; d, anthers; e, style. 6, style enlarged with two stigmas and pollen grains on style; 7, syngenesious anthers cut lengthwise to show pollen grains and tailed appendages; 8, single pollen grain. (Charlotte M. King).

the *Inula Helenium,* native to Europe and occasionally naturalized in the northern states. It is a mild tonic and contains *inulin* $C_6H_{10}O_5$, *helenin* and a volatile oil. The pellitory root (*Anacyclus Pyrethrum*) contains *pyrethrin* with a pungent taste, which, according to Dunstan, is apparently identical with *piperovatin* $C_{16}H_{21}NO_2$, used for toothache; the flowers of Roman chamomile (*Anthemis nobilis*) are used as a tonic and stomachic. However, German chamomile (*Matricaria Chamomilla*) is sometimes substituted for the preceding and contains *anthemidin* and a deep-blue volatile oil. Santonica, a species of wormwood, *Artemisia Cina,* contains *santonin* $C_{15}H_{18}O_3$, and *cinerol* $C_{10}H_{18}O_6$, is found in the volatile oil, an anthelmintic. *Artemisia maritima, A. pontica, A. Absinthium, A. biennis* and *A. Abrotanum* are also used for the dislodgement of worms. The latter contains the alkaloid *abrotanin* $C_{21}H_{22}H_2O$. Sage brush (*Artemisia tridentata*) and other species produce sneezing.

Wormwood (*Artemisia Absinthium*) is a stimulant and tonic; the volatile oil produces cerebral disturbances and enters into the familiar composition of absinthe, made by the French, and contains *absinthin* $C_{15}H_{20}O_4$. Arnica root (*Arnica montana*) native to arctic Asia and America, is used as a popular remedy for chilblains and bruises and contains the bitter principle *arnicin* $C_{20}H_{30}O_4$. The tincture is liable to produce a form of dermatitis. Dandelion root (*Taraxacum officinale*) is used as a mild laxative and tonic and contains a bitter principle *taraxacin*, and *taraxacerin* $C_9H_{15}O$. *Lactucarium*, the milky juice from several species of the genus *Lactuca* occurs in lettuce, in which is also found *lactucopicrin*, a bitter acrid substance, and *lactucol* $C_{21}H_{34}O$. Colt's foot (*Tussilago Farfara*), a bitter astringent containing much mucilage, is used for asthma. The costus (*Saussurea Lappa*) produces flowers with thistle-like heads and large roots, the latter of which are used as a perfume and an incense; according to Kraemer, it contains a ketone. The musk tree (*Olearia argophylla*) of Tasmania, whose leaves emit a musk-like odor, grows to a height of 20 feet and is often 1 foot in diameter. The wood takes a nice polish. Other trees of the order are found in the genus *Senecio* (*Senecio Forsteri*). The genus *Baccharis*, found along the sea coast, is shrubby. The *B. cordifolia* contains *baccharin*, an alkaloid poisonous to sheep. It is the Mio Mio of South America.

The button snake root (*Liatris spicata*) has been used as a remedy for snake bites, but it probably contains no antidotal properties whatever. Boneset (*Eupatorium perfoliatum*) and other species much used in domestic medicines for colds, and in large doses are emetic. They are tonics, emetics, cathartics, and diaphoretics containing the bitter glucoside *eupatorin*. Horseweed (*Erigeron canadensis*) and other species are used as tonics and astringents.

Golden-rod (*Solidago odora*) is used to relieve colic, and gumweed (*Grindelia squarrosa*) is beneficial in catarrhal affections. It is said to contain an alkaloid known as *grindelin*. Madia oil is obtained from tarweed (*Madia sativa*). The niger seed, the fruit of *Guizotia abyssinica*, is an important source of oil in Abyssinia and India.

The root of the burdock (*Arctium Lappa*), used by the laity as a remedy in skin diseases, contains a bitter glucoside, *lappin*. Chicory (*Cichorium Intybus*) is used to increase the appetite and to aid digestion. Rattlesnake weed (*Hieracium venosum*) is a popular antidote to the bites of poisonous snakes. Rattlesnake root (*Prenanthes alba*) is used as a remedy for toothache. The ragweeds (*Ambrosia artemisiifolia* and *A. trifida*) are stimulants and astringents, the larger weed being also supposed to cause hay fever.

Dunbar has demonstrated that the producing cause of hay fever may be pollen, and that pollen of all grasses, lillies of the valley, asters, and certain other plants may produce an irritation similar to that accompanying hay fever. He isolated an active principle which is believed to be a tox-albumin. A very interesting account of his experiments is given by Rochussen in the twenty-sixth volume of the Pharmaceutical Review.

According to Maiden, the *Helichrysum apiculatum* of Australia causes death from irritation and from the formation of hair balls. The African marigold is poisonous to stock and the may weed (*Anthemis Cotula*), when applied to the surface, causes vesication. The European prickly lettuce (*Lactuca virosa*) contains a bitter principle, *hyoscyamin*; the prepared milky juice is called *Lactucarium.* It is listed as poisonous by Lehmann; a small amount of *hyoscyamin* also occurs in the cultivated lettuce.

The seeds of the sunflower (*Helianthus annuus*) are said to be diuretic. The oil cake from these seeds is used as stock food. Sneeze weed (*Helenium autumnale*) is used by the Indians to produce sneezing; a decoction made from it is used as a tonic. The mayweed (*Anthemis Cotula*) acts like chamomile, and is used as a tonic and stimulant in colic; when applied to the skin, it causes vesication. Yarrow (*Achillea Millefolium*), a stimulant and tonic, contains *achillein,* $C_{20}H_{38}N_2O_{15}$. The oil of tansy (*Tanacetum vulgare*) is used as an abortifacient, in many cases with fatal results. It contains the substance *thujone,* found in *Thuja occidentalis.* This has commonly been called *tanacetin* $C_{11}H_{16}O_4$, and is identical with *absinthol* obtained from absinthium, and with *salviol* from salvia. The *Cnicus benedictus* contains *cnicin* $C_{20}H_{37}O_{10}$.

Of the many cultivated plants of this order used for ornamental purposes, the best known in the northern states are probably the bachelor's button (*Centaurea Cyanus*), a native of Europe, ageratum (*Ageratum conyzoides*), Chinese aster (*Callistephus hortensis*), garden daisy (*Bellis perennis*), and dahlia (*Dahlia variabilis*), native to Mexico, running into many varieties. The last named produces thickened roots, that contain a great deal of *inulin,* $C_6H_{10}O_5$. Among the species of the order which are common in the gardens are the zinnia (*Zinnia elegans*), golden glow (*Rudbeckia laciniata*), sunflower (*Helianthus annuus*), coreopsis (*Coreopsis tinctoria*), gaillardia (*Gaillardia pulchella*), dusty miller or cineraria (*Senecio Cineraria*), common cineraria (*S. cruentus*) from the Teneriffe, and the purple ragwort (*S. elegans*) from the Cape of Good Hope, yarrow (*Achillea Ptarmica*), whiteweed (*Chrysanthemum Parthenium*), several species of the genus chrysanthemum from Japan (*C. sinense* and *C. indicum*), Marguerite (*C. frutescens*) and summer chrysanthemum (*C. coronarium*), marigold (*Tagetes erecta*), the pot marigold (*Calendula officinalis*), cosmos (*Cosmos bipinnatus*) of Mexico. The marigold (*Calendula officinalis*) cultivated in country gardens contains *calendulin* $C_6H_{10}O_5$.

Of the economic plants, the following are the more important: the cultivated lettuce (*Lactuca sativa*), probably native to Asia, slightly narcotic, comprising many varieties; the safflower or saffron (*Carthamus tinctorius*), native to Egypt, used for dyeing; marigold flowers (*Calendula officinalis*) sometimes used as an adulterant for saffron; wormwood (*Artemisia Absinthium*), used for making absinthe; tarragon (*Artemisia Dracunculus*) used as a pot-herb and in making vinegar, a native of Asia, but cultivated now in Holland and England; the Jerusalem artichoke (*Helianthus tuberosus*), with thickened roots, cultivated as food for hogs and stock, native to North America; the great sunflower (*Helianthus annuus*), the seeds of which are eaten in Russia, and from which an oil is obtained; the chicory (*Cichorum Intybus*); the burdock (*Arctium minus*), cultivated for its thick root which is sometimes dried and mixed with coffee and also used as a forage plant; the endive (*Cichorum endivia*) cultivated as a winter salad plant; the cardoon (*Cynara Cardunculus*), also known as the European artichoke, used as a vegetable, the thickened scales being used as food; salsify (*Tragopogon porrifolius*) a vegetable, and the dandelion (*Taraxacum officinale*) used like lettuce.

The Compositae are divided into two sub-families: the *Tubuliflorae* with corolla tubular in all the perfect flowers, 5-lobed, rarely 3-4-lobed, ligulate only in the marginal flowers, called the ray flowers, which are absent in some species; the *Liguliflorae* with corolla ligulate in all the flowers of the head and all the flowers perfect; herbs with milky juices and alternate leaves: The former contains the tribes *Vernonieae,* with the large genus Vernonia of 450 species mostly of the tropics; the *Eupatorieae,* containing *Eupatorium; Astereae,* containing *Solidago, Aster, Erigeron, Grindelia, Bigelovia; Inuleae,* containing *Inula, Antennaria; Heliantheae,* containing *Silphium, Parthenium, Helianthus, Bidens, Coreopsis*; the *Helenieae* with *Helenium, Actinella*; the *Anthemideae* with *Anthemis, Achillea, Tanacetum;* the *Senecioneae* with *Senecio, Tussilago;* the *Cynareae* with *Arctium, Cnicus, Cirsium* and *Centaurea.* The *Liguliflorae* contain but one tribe, the *Cichorieae,* which contains the genera *Taraxacum, Cichorium, Lactuca, Hieracium, Sonchus* and *Scorzonera.*

Genera of Compositae

Corolla ligulate in all of the flowers of the head; flowers perfect.

LIGULIFLORAE CICHORIEAE

Pappus none ....1. Cichorium

Pappus composed of capillary bristles.

Flowers yellow, achenes not beaked............................2. Sonchus

Flowers yellow, purplish or cream colored.

Achenes beaked ....3. Lactuca

Achenes not beaked ....4. Lygodesmia

Corolla tubular in perfect flowers, 5 or rarely 3 or 4-lobed; lingulate only in the marginal flowers. TUBULIFLORAE

Stamens distinct or nearly so. AMBROSIEAE.

Staminate and pistillate flowers in the same head.....................5. Iva

Staminate and pistillate flowers in a separate head.

Involucre of pistillate heads with several tubercles.......6. Ambrosia

Involucral bracts of pistillate flowers forming a bur......7. Xanthium

Stamens generally united by their anthers into a tube around the style.

Anthers not tailed.

Style branches thickened upward, papillose. EUPATORIEAE.

Achenes 3-5 angled, flowers discoid................8. Eupatorium

Achenes 8-10, ribbed or striate.

Bracts of involucre in several series................9. Liatris

Bracts of involucre in 2 or 3 series................10. Trilisa

Style branches of perfect flowers flattened with terminal appendages. ASTEREAE.

Ray flowers yellow.

Pappus of scales or awns...................11. Grindelia

Pappus of numerous capillary bristles........12. Solidago

Ray flowers not yellow, bracts nearly equal......14. Erigeron

Bracts in several unequal series.................13. Aster

Style branches truncate or hairy appendaged. HELIANTHEAE.

Pappus wanting or minute crown..................15. Rudbeckia

Pappus of 2 persistent downwardly barbed awns or tubes.......... ....16. Bidens

Style branches truncate or with hairy tips. HELENIEAE.
  Bracts of the involucre spreading.
    Receptacle naked; bracts of involucre spreading or reflexed at maturity ....17. Helenium
  Bracts of the involucre united.......................18. Dysodia
Style branches mostly truncate with brush hairs on the tip. ANTHEMIDEAE.
  Pappus of short scales or a crown.
  Scales of involucre scarious and imbricated.
    Receptacle chaffy.
      Heads small; involucre obovoid or campanulate; achenes flattened. ....19. Achillea
      Heads large; achenes terete................20. Anthemis
      Heads solitary or corymbose.
    Receptacles not chaffy.
      Ray flowers usually present, conspicuous...21. Chrysanthemum
      Ray flowers inconspicuous.................22. Tanacetum
      Heads small spicate or racemose paniculate.23. Artemisia
Style branches truncate or triangular with brush hairs.
      Heads radiate or discoid.
  Pappus of capillary bristles. SENECIONIDEAE.
      Heads showy, leaves opposite..................24. Arnica
      Heads usually showy, leaves alternate........25. Senecio
Style branches short or united, anthers caudate. CYNAREAE
  Achenes basi-fixed.................................26. Arctium
    Involucral bracts pointed or prickly.
    Receptacle densely bristly........................27. Cirsium
    Receptacle honey-combed.........................29. Silybum
  Achenes attached laterally.
    Pappus of short scales.........................28. Centaurea

LIGULIFLORAE

Herbs with milky juice. Corolla ligulate in all of the flowers of the head, and all of the flowers perfect.

1. *Cichorium* (Tourn.) L. Chicory

Erect branching perennial or biennial herbs with alternate leaves; involucre of two series of herbaceous bracts, the inner of 9-10 scales, the outer of 5 short spreading scales; receptacle flat, naked or slightly fimbriate; flowers bright blue, purple or pink; rays 5-toothed; Achenes striate; pappus of numerous small chaffy scales forming a crown.

About 8 species of the old world.

Cichorium Intybus L. Chicory or Succory

A branching perennial with deep roots and alternate leaves; basal leaves spreading on the ground; stem leaves oblong or lanceolate, partly clasping.

Distribution. Common along roadsides and in fields and waste places from New England to Canada and Nebraska, especially where chicory has been cultivated. It has become a troublesome weed in Wisconsin and Minnesota. It is allied to endive (*Chicorium Endivia*), cultivated as a salad plant.

Poisonous properties. When fed in large quantities it imparts a bitter flavor to milk and butter. It contains the bitter glucoside *chicorin* $C_{32}H_{24}O_{10}$. Chicory root is used as an adulterant of coffee.

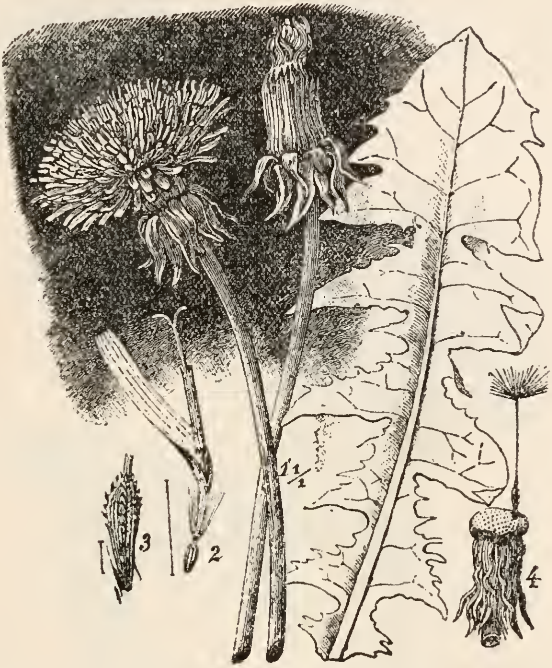

Fig. 439b. Dandelion (*Taraxacum officinale*). 1, Single head during flowering, single head after flowering. 2, Single flower with corolla stamens and style. 3, Achenium. 4, Receptacle and single achenium. (After Strasburger, Noll Schenck and Schimper).

2. *Sonchus* (Tourn.) L. Sow Thistle

Annual or perennial herbs with alternate, mostly auriculate-clasping, entire lentate, lobed, or pinnatifid leaves with soft prickly margins; flower heads in orymbose or paniculate clusters; involucre bell-shaped; scales imbricated in everal rows; receptacle flat and naked; achenes oblong, more or less flattened; 0-20-ribbed; pappus of soft white capillary bristles.

About 45 species of the old world.

Sonchus oleraceus L. Annual Sow-thistle

Annual or perennial succulent herbs with leafy stems, smooth and glauous with corymbed or umbellate heads of yellow flowers. Stem leaves dentate, uncinate-pinnatifid, terminal segments large and triangular; heads numerous; lowers pale yellow, occurring in summer and fall.

Distribution. Common in fields and waste places throughout North Amerca, except far northward. Also from Mexico to South America.

Sonchus arvensis L. Field Sow-thistle

A glabrous perennial, producing deep creeping root-stock, stem leafy, ranched, basal leaves runcinate-pinnatifid, spiny-toothed, clasping by a heart-haped base; flowers yellow; achenes transversely wrinkled.

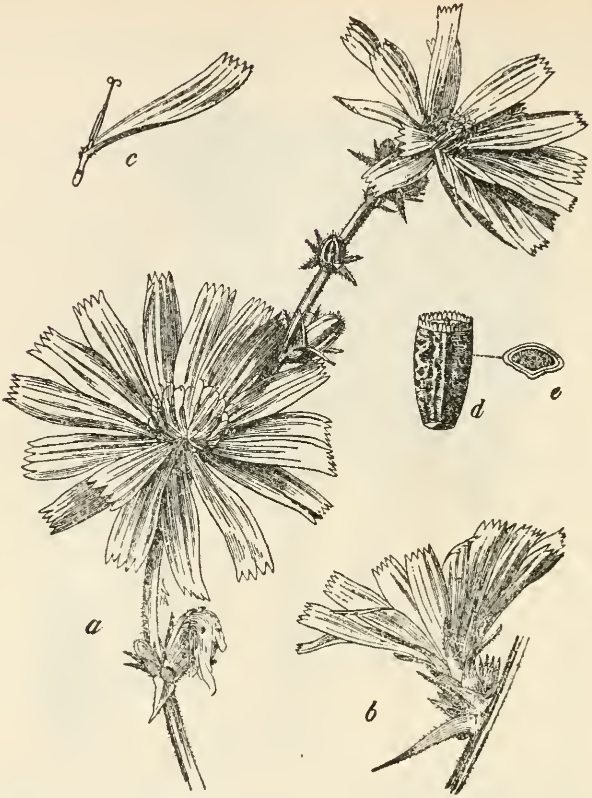

Fig. 439c. Chicory (*Chicorium Intybus*). a, part of plant with several heads; b, single head side view; c, single flower with strap shaped corolla; d, achenium with small chaffy scales. (U. S. Dept. Agrl.)

Distribution. Common in eastern states, Canada (Manitoba) and occasionally in Wisconsin, Illinois, Iowa and Utah.

Poisonous properties. The plants are more or less bitter and not liked by cattle. Their milky juice probably contains some active principle.

3. *Lactuca* (Tourn.) L. Lettuce

Tall, leafy-stemmed herbs with milky juice and alternate leaves; flowers white, yellow or blue, in panicled heads; involucre cylindrical, bracts imbricated in two or more series; receptacle flat, naked; anthers sagittate at the base; achenes oval, oblong or linear, abruptly contracted into a beak, dilated at the apex, bearing a soft white capillary or brown pappus.

About 90 species, natives of the northern hemisphere. Garden lettuce (*L. sativa*), native to Europe, is cultivated.

Lactuca Scariola L. Prickly Lettuce

Tall, erect herbs, annual or winter annual, 2-6 feet high, simple or branched except the lower part of the stem which has stiff bristles; leaves glaucous, green, smooth except the midrib which is beset with weak prickles; lanceolate to oblong in outline with spinulose, denticular margins occasionally sinuate toothed, sometimes pinnatifid; base sagittate clasping; leaves becoming vertical by a twist; the leaves are not twisted in shady situations; flowers in small open panicled heads; each head has from 4-18 yellow flowers; achenes flat, striate nerved, obovate, oblong, produced in long filiform beak which is paler in color than the achene; pappus consists of delicate white bristles arising at the end of the beak.

Distribution. Prickly lettuce is a native of temperate and southern Europe, Canary Islands, Maderia, Algeria, Abyssinia, and the temperate regions of eastern Asia. It was introduced into North America about 1863.

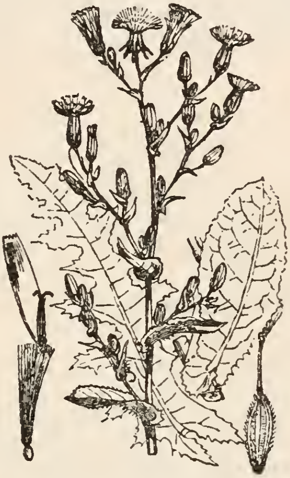

Fig. 440. Prickly Lettuce (*Lactuca Scariola*). After Fitch.

Lactuca canadensis L. Wild Lettuce

A tall, leafy, smooth or occasionally somewhat hairy biennial 4-9 feet high; leaves 6-12 inches long; stem leaves sessile or auriculate clasping, the upper leaves smaller, lanceolate acuminate and entire; heads with about 20 flowers in spreading panicles; involucre cylindrical; rays yellow; achene somewhat longer than the beak.

Distribution. In moist places, borders of thickets and in fields from Nova Scotia to Manitoba, south to Arkansas, Louisiana and Georgia.

Lactuca pulchella (Pursh.) D. C. Blue Lettuce

A glabrous perennial, with milky juice, simple stem from 1-2 feet high, sessile, oblong or linear lanceolate entire leaves the lower runcinate-pinnatifid; heads corymbose paniculate, peduncles with scaly bracts; scales of the involucre imbricated in 3 or 4 ranks; flowers blue; achenes oblong lanceolate, somewhat flattened.

Distribution. Native to the plains from western Iowa north to Manitoba and west to the Great Basin and California, and rare as far east as Michigan. A troublesome weed in grain fields of Montana and Utah.

Poisonous properties. The wild blue lettuce is common in the west but is not liked by cattle although sometimes eaten by sheep. It has been regarded with suspicion. The cultivated lettuce contains several active principles as follows: *Lactucorol* $C_{18}H_{30}O$, *lactucol* $C_{21}H_{34}O$, a small amount of *hyoscyamin*. The bitter taste of *L. canadensis* is due to *lactucrin* $C_{22}H_{34}O_8$, and *lactucopicrin* $C_{44}H_{64}O_{21}$. I quote Dr. Millspaugh in regard to the physiological action of *L. canadensis.* "Lactucarium, in large doses, causes: delirium, confusion of the brain, vertigo and headache, dimness of vision, salivation, difficult deglutition, nausea and vomiting, and retraction of the epigastric region, with a sensation of tightness; distension of the abdomen, with flatulence; urging to stool followed by diarrhoea; increased secretion of urine; spasmodic cough, oppressed respiration, and tightness of the chest; reduction of the pulse ten to twelve or more beats; unsteady gait; great sleepiness; and chills and heat, followed by profuse perspiration." The *L. virosa,* a wild lettuce of Europe, and occasionally in the Mississippi Valley, but never abundant westward, is regarded in Europe as poisonous.

4. *Lygodesmia* D. Don.

Low smooth perennial herbs with linear leaves or the lower somewhat pinnatifid, the upper of scales; heads 3-12 flowered, a single one terminating the branch; flowers purple or pink; achenes smooth or striate; pappus of copious, somewhat unequal simple bristles.

About 6 species of western North America.

Lygodesmia juncea (Pursh.) D. Don.

A tufted smooth, frequently glaucous perennial, a foot or more high, coming from a thick woody root, copious milky juice and stems; lower leaves rigid, linear lanceolate, entire, the upper scale-like; heads erect with purple flowers; achenes narrow-ribbed, pappus light brown.

Distribution. Common on the plains from the Missouri river to western Montana, Northwest Territory and east to the St. Croix river in Wisconsin. This has been reported as a troublesome weed in corn fields in northwest Iowa, troublesome also in Colorado and Montana.

Poisonous properties. The plant is bitter like many others belonging to sub-family *Cichoriaceae.* The milky juice no doubt contains some deleterious properties. The plant is not liked by stock.

Professors Chesnut and Wilcox say with reference to the species in Colorado:

> "This species, sometimes known as prairie pink, grows abundantly on dry prairies and plains in Park, Sweet Grass, Gallatin, Meagher, Lewis and Clarke, Choteau, and Teton counties. The general distribution of the plant is from Minnesota to New Mexico and Nevada. It has been suspected by stockmen both in Montana and Utah of being poisonous to stock. The plant was not investigated, but it was ascertained that the milky orange-colored juice of nonflowering plants gathered at Toston was extremely bitter and disagreeable to the taste."

TUBULIFLORAE

Corolla tubular in all the perfect flowers, 5-lobed, rarely 3-4-lobed, or ligulate only in marginal flowers, called the ray flowers which are absent in some species.

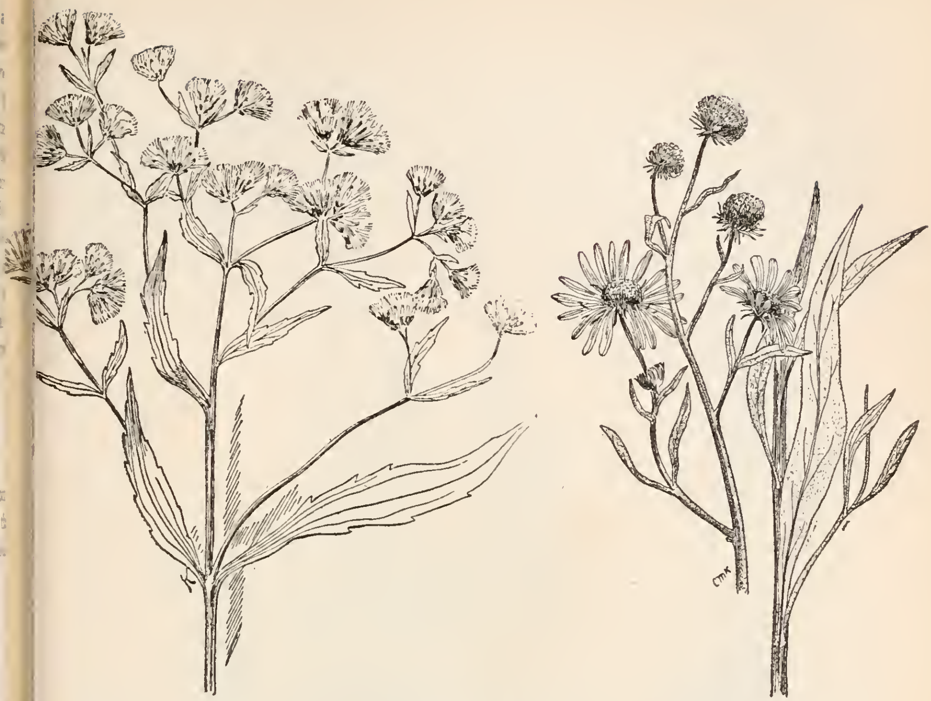

Fig. 440a. Boneset (*Eupatorium altissimum L.*) Common in the Mississippi valley. At the right Maxmillian's Sunflower (*Helianthus Maximiliani*) common in Mississippi valley. (Charlotte M. King).

Iva L. Marsh Elder

Herbaceous or some shrubby plants, pistillate and staminate flowers in the same head. The lower leaves opposite, the upper alternate; flowers greenish, rays absent; subtended by an involucre of hemispherical or cup-shaped bracts; achenes obovoid or lenticular, without pappus.

About 12 species of western and southern America.

Iva axillaris Pursh. Small-flowered Marsh-elder

A smooth or sparingly pubescent perennial with herbaceous stems, from 1-2 feet high, with woody roots; leaves sessile, entire or nearly so; obovate, oblong or linear oblong, the lower opposite, the upper smaller and alternate; heads generally solitary in the axils of the leaves, short petioled, involucre hemispherical, pistillate, flowers with tubular corolla.

Distribution. Common especially in the saline soils from Nebraska to the Dakotas, British Columbia, California and New Mexico.

Iva xanthifolia Nutt. Marsh Elder

An annual from 1-8 feet high; stem frequently pubescent when young; all the leaves opposite, rhombic, ovate or the lowest heart-shaped, doubly serrate or cut-toothed, obscurely lobed; the upper surfaces minutely scabrous, canescent beneath, especially when young; petiole frequently ciliate at its upper end; flowers born in spike-like clusters forming a compound panicle; heads small, crowded; outer bracts of the involucre broadly ovate, greenish; inner membranaceous; achenes glabrate.

Distribution. In alluvial ground or along streams, Saskatchewan and Nebraska to New Mexico, Utah and Idaho. In the western part of the state of Iowa this weed is extremely common as in Woodbury, Harrison, Monona and Fremont counties. It occupies not only the vacant lots but is found in the streets and cornfields. To the west in Nebraska it becomes increasingly abundant and in the irrigated fields of portions of Colorado it is frequently 8 feet high. It is common in the Red River Valley of the North and other parts of Minnesota and Dakota, and Manitoba. It is a most aggressive weed.

Poisonous properties. This plant and the preceding produce an unusually large amount of pollen and have been looked upon as in part responsible for hay fever, the pollen being simply an irritant of the nasal mucous membrane.

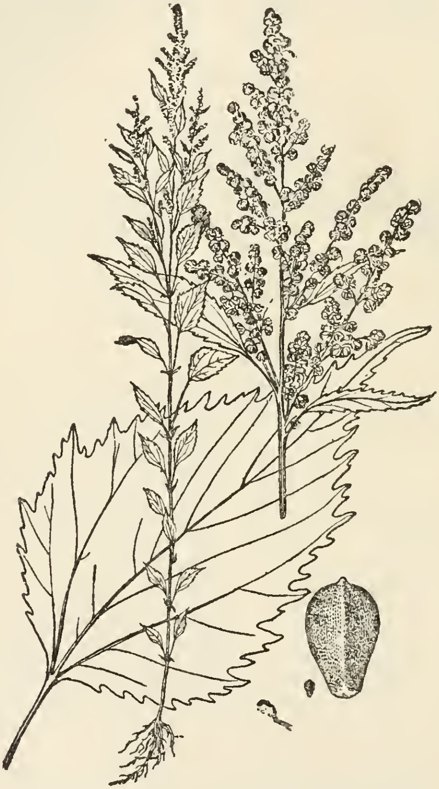

Fig. 441. False ragweed (*Iva xanthifolia*). The pollen is possibly a cause of hay fever. (Dewey, U. S. Dept. Agr.).

6. *Ambrosia* (Tourn.) L. Ragweed

Herbs; leaves alternate or opposite, lobed or dissected; flowers in heads, fertile, 1-3 together, sessile in the axils of leaves or bracts; involucre of the pistillate flowers top-shaped, ovoid or globose, closed, 1-flowered, armed with 4-8 tubercles or spines; corolla none; pappus none; involucre of the staminate flowers saucer-shaped, 5-12 lobed, many flowered; receptacle nearly flat or with filiform chaff; corolla funnelform, 5-toothed, anthers but slightly united; achenes ovoid.

The twelve species are mostly native of North America.

Ambrosia trifida L. Great Ragweed, Ironweed

A stout, scabrous, hispid or nearly glabrous annual, 3-12 feet high; leaves opposite and petioled, 3-nerved, deeply 3-5-lobed, the lobes ovate, lanceolate and serrate, the upper leaf sometimes ovate and undivided; flowers monoecious,

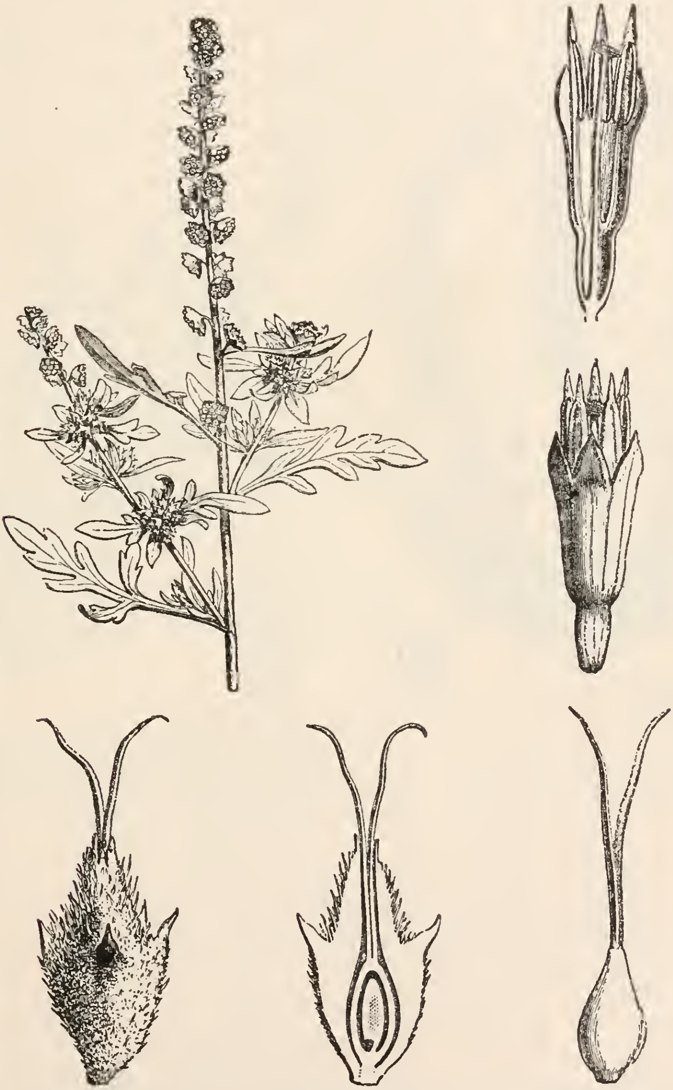

Fig. 442. Ambrosia showing flowering stalk, pistils, stamens, and longitudinal sections of stamens in perianth and ovary. (After Faguet).

staminate borne in spikes surrounded by the larger bract-like leaves; the involucre is turbinate to ovoid, 5-7-ribbed, beaked, each rib bearing a tubercle near the summit; the involucre enclosing a single achene.

Distribution. The greater ragweed is distributed from Quebec to Florida throughout the Atlantic region to Texas, common throughout the Mississippi Valley west to Colorado and Northwest Territory, in Manitoba and Saskatchewan.

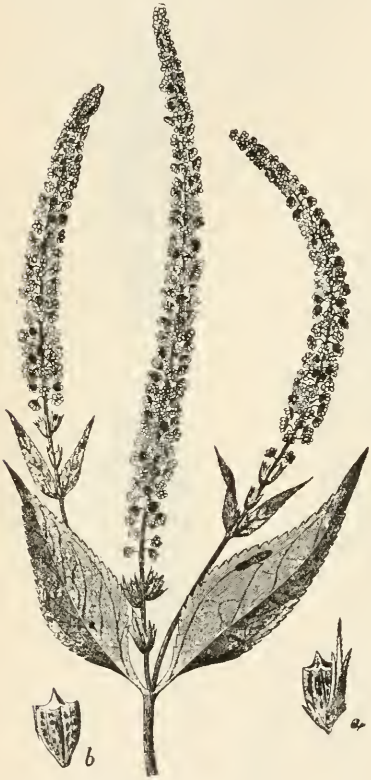

Fig. 443. Tall ragweed (*Ambrosia trifida*). (U. S. Dept. Agr.)

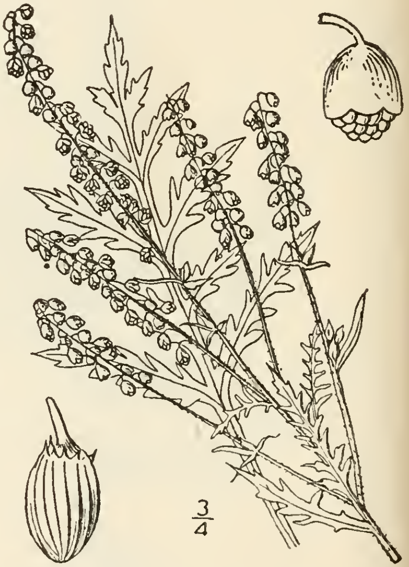

Fig. 444. Small Ragweed (*Ambrosia artemisiifolia*). In the lower left hand corner is a bur that contains the seed; upper right hand corner, a flower; in middle, branch and leaf. Probably poisonous. (Holm-Britton).

Ambrosia artemisiifolia L. Hogweed. Bitterweed

A puberulent or hirsute branched annual 1-3 feet high; leaves thin, once to twice pinnatifid; the upper alternate, the lower usually opposite, pale or canescent beneath; flowers monoecious, the staminate above and the pistillate in the lower axils of the leaves; the fertile heads are obovoid or globose, short beaked and 4-6 spined.

Distribution. A troublesome weed in northern states. Its distribution in North America is from Nova Scotia to Florida throughout the Atlantic states and Mississippi Valley; in the Rocky Mountain region and west to British Columbia; also in Mexico and the West Indies and South America.

Poisonous properties. The greater ragweed is regarded as especially troublesome as an exciting cause with reference to hay fever. The following from Dr. Johnson on this point is of interest:

> These plants are said to be stimulant, tonic, and astringent. A decoction has been used, chiefly in domestic practice, as a topical astringent in chronic catarrhal affections.
>
> Of late years *A. artemisiifolia* has attracted considerable attention on account of its real or assumed agency in the production of hay-fever. The plant produces pollen in great abundance, which is extremely irritating to the air-passages of many people, and is capable of exciting asthmatic attacks in susceptible persons. Now as the weed is so very abundant, and its time of flowering coincident with the greatest development of hay-fever, the relation of cause and effect has been asserted by many writers. That it may be so in a certain proportion of cases is quite probable, but that its influence in this direction has been overrated is still more probable. The pollen of all plants is irritating to the air-passages of sensitive people, but probably little more so than any other dust of an organic character; and the proportion which rag-weed pollen in the air of any specified locality bears to that of all other plants combined must be very small indeed. Much less still must its proportion be to other pollen and organic dust in the air of cities, where this affection has become endemic—and fashionable.,

The ragweeds, marsh elder, goldenrod, and chrysanthemum, as well as the pollen of some grasses, are said to produce hay fever. In recent years a toxic substance has been isolated which belongs to a class of poisonous substances known as toxalbumin.

The fact that this troublesome disease is caused by a poisonous toxin has led to a study of serum treatment by Dunbar* who has produced an antitoxin which he calls "pollantin," and Weichardt** another called "graminol." Pollantin is obtained from the blood serum of horses which have been immunized with the pollen toxin. Dunbar's hay fever serum is sold both as a powder and as a fluid. There are those, however, who believe that hay fever is not due to poison by pollen toxin so that this treatment can be of no use. A. Wolff-eisner*** attributes the action of the serum not to antitoxins but to colloidal substances. Weichardt prepared the serum from the blood of herbiverous animals. Sattistics of The Hay Fever Union of Germany for 1906 indicate that the results with the treatment of "graminol" were favorable.

A correspondent from Nebraska sent to the writer a specimen of the small ragweed stating that it was abundant in his pasture and that where cattle used it as forage, the mouths of these animals became very sore. The plant is bitter and possibly may be irritating at times. There were no parasitic fungi on the specimens sent us.

7. *Xanthium* (Tourn.) L. Cocklebur. Clotbur

Coarse low branching annual herbs with alternate toothed or lobed petioled leaves; monoecious flowers; staminate flowers with a short involucre of several distinct bracts, receptacle cylindrical; pistillate flowers with a closed involucre, covered with hooked prickles; 2-celled, 2-flowered, in fruit forming a bur; achenes oblong, flat, without pappus.

The 12 species are widely distributed.

Xanthium spinosum L. Clotbur

A pubescent branched annual herb with slender yellow 3-parted spines in the axils; leaves lanceolate or ovate lanceolate, white downy underneath; bur oblong cylindrical, armed with single short beak and numerous glabrous prickles.

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* Deutsch Med. Woch. 1903:140.
Berlin Klin. Woch. 1903:24, 25, 26, 28.

** Klinisch-ther. Woch. 1903:1457.

*** Das heufieber, sein wesen und seine Behandlung. München 1906. In this connection the very excellent review on Serum Therapy in E. Merk's Annual Report, 1909, Vol. 23 should be consulted.

Distribution. Common in waste grounds from Ontario to Missouri and Texas to Florida. Native to the old world.

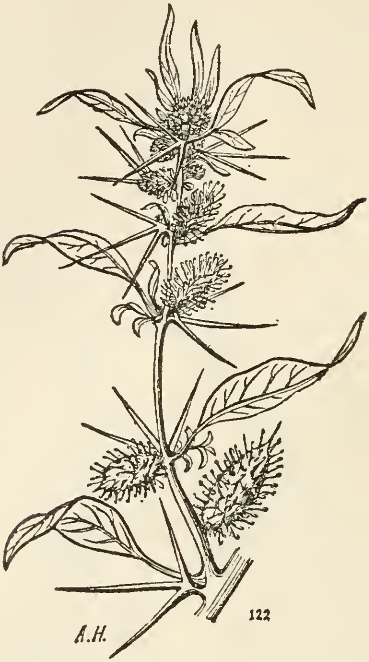

Fig. 445. Thorny Clot-bur (*Xanthium spinosum*). After Hochstein.

Xanthium Strumarium L.

A low, rough, branching annual from 1-2 feet high; leaves slender, petioled, broadly ovate or orbicular, 3-5-lobed, both surfaces rough; bur oblong, smooth or nearly so, with two straight or nearly straight beaks.

Distribution. In waste places along the Atlantic seacoast. Native to Europe.

Xanthium canadense Mill. Cockle Bur

A coarse rough annual from 1-3 feet high, stem marked with brown punctate spots; leaves alternate, cordate or ovate, 3-nerved, long petioled; flowers monoecious, staminate and pistillate flowers in different heads, the pistillate flowers clustered below; the involucre of the staminate flowers somewhat flattish of separate scales, receptacles cylindrical; scales of the fertile involucre closed in fruit, 2-beaked, containing 2 achenes; the bur is densely prickly and hispid, achenes oblong without pappus.

Distribution. In Iowa this species is very common along the sandy bottoms of our streams and river courses. It is less troublesome in uplands but here and there it does occasion some trouble even in the central and southern part of the state. However, in southern and southeastern Iowa the weed is often quite troublesome in cornfields, coming up in enormous quantities. In Texas, too, it appears in the very richest soil. Its distribution in North America is from Nova Scotia to North Carolina, southwest to Texas and west through Colorado, Utah and Nevada, and north to Saskatchewan and Manitoba. Most abundantly developed in the Mississippi Valley region from Minnesota to Texas.

Poisonous properties. The injury from this plant probably comes largely from its mechanical action. As the involucre is indigestible, its barbs sometimes injure an animal feeding upon it. Stock will probably not eat very much of it, but on account of the hooked awns of the involucre the animal may have considerable difficulty in removing them. The hairs of the plant cause itching. Several cases of poisoning of hogs, probably due to this plant, have been reported to me. The plant contains the poisonous glucoside *xanthostrumarin* which resembles *datiscin*. On heating, the odor of succinic acid is given off. According to Chesnut, the young seedlings of three species of cockle bur, among them our Canadian cockle bur (*Xanthium canadense*) are poisonous to hogs. Dr. Bitting was unable to find a poisonous substance in the growing plants. He thinks the injurious properties are largely mechanical.

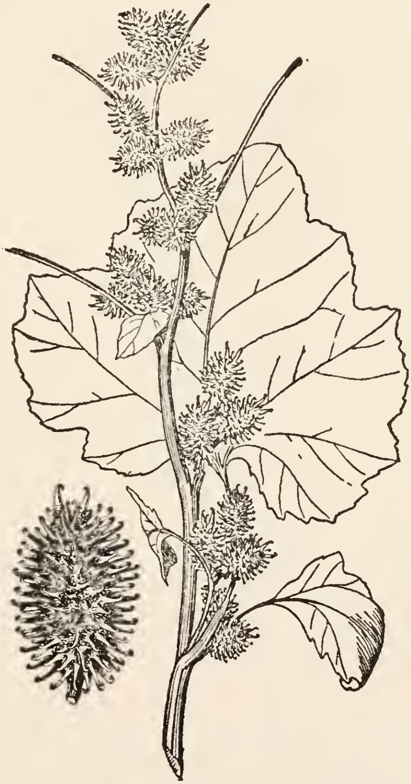

Fig. 446. Cockle-bur (*Xanthium canadense*). Cause of mechanical injuries to animals. (Dewey, U. S. Dept. Agrl.)

A writer in the American Agriculturist says:

When the seed is ripe the bristles are very hard and sharp, and in the stomach and intestines of the animal, mat or felt together by the aid of their barbs, forming large balls, which obstruct the intestines and prove fatal. In these cases, death is evidently not from any poisonous quality of the hay, but is due to mechanical causes. While Cocklebur may not be poisonous, it may in a similar manner kill swine by mechanical obstructions. When the burs are ripe, they readily leave the plant, and attach themselves to the coat of any passing animal. The plant is especially annoying to sheep owners, as these burs become entagled in the wool. Those who have traveled in Texas and Mexico, soon make acquaintance with the cockle bur. Horses and mules, while grazing for a single night, will have their tails clotted with these burs, and converted into a useless club. It can be understood, that if swine eat the burs in considerable quantity, the pieces of them can, by means of the prickles, form masses which may prove fatal. Both on account of its probable danger to swine and its injury to sheep, there should be an united effort to destroy the plant. Being an annual, its extermination would not be difficult. If the plants are cut down before the seed is ripe, new ones can not appear unless the ground is re-seeded.

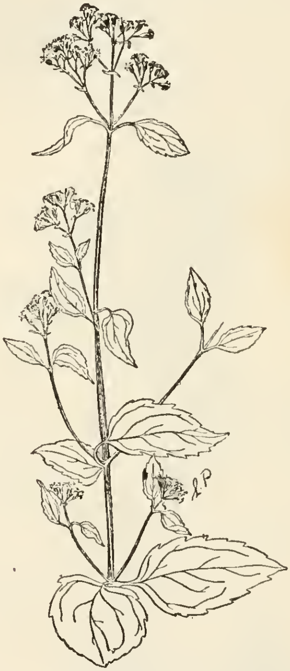

Fig. 447. Boneset (*Eupatorium urticaefolium*). A common plant in woods. It is supposed by some to cause milk fever or trembles. Branches with numerous small heads. (Lois Pammel.)

8. *Eupatorium* (Tourn.) L. Boneset

Erect perennial herbs with opposite, whorled or alternate leaves, often sprinkled with resinous dots; flowers in corymbose heads, white, bluish, or purple; bracts of the involucre in two series; receptacle naked; corolla regular, tube short 5-lobed; branches of the style slender, thickened upward or club-shaped, very minutely and uniformly pubescent, with stigmatic lines indistinct; achenes 5-angled, truncate; pappus of numerous fine capillary bristles, arranged in one row.

About 450 species in warm temperate and tropical regions. An oil is made from the southern *E. capillifolium*, which has an aromatic, pepper-like odor.

The boneset (*E. perfoliatum*), is commonly used as a domestic remedy, employed in catarrhal affections and fevers. The Joe-Pye weed (*E. purpureum*) is used in urinary affections.

Eupatorium urticaefolium Reichard. White Snake-root

A smooth or nearly smooth branching herb from 2-3 feet high; leaves opposite, thin rounded, cordate at the base or abruptly narrowed into a slender petiole, coarsely and sharply toothed; heads in ample and loose corymbose clusters; flowers white; involucre narrowly campanulate; bracts linear, acute or acuminate.

Distribution. Common in rich woods from New Brunswick to South Dakota and Nebraska to Indian Territory and Louisiana.

Poisonous properties. This plant is said to produce the disease known as trembles in cattle, horses and sheep, and milk sickness in people. Mr. E. L. Mosely states that:

> Milk-sickness is known to be due to the use of milk, butter, cheese or meat of animals afflicted with the trembles, but what causes the trembles has not been well understood. It has long been known that only the animals allowed to run in the woods were affected, and experience showed that certain woods were very dangerous, while others were safe. People who came from Pennsylvania with a view to settling here returned to their own State on learning of the peril of pasturing animals in Ohio. To this day many woods in this district are not pastured, because animals would soon die if turned into them.
>
> The Eupatoriums are not palatable. Anyone who has tasted boneset will admit that this is true of *Eupatorium perfoliatum*. In the South I have observed that animals leave *Eupatorium serotinum* untouched even where they have been confined so as to eat almost every other green thing in reach. In northern Ohio I have found *Eupatorium urticaefolium*, the white snake-root, growing abundantly in a number of woods where animals were pastured but no sign of their having eaten it. But if the pasture becomes poor, some are likely to eat it.
>
> On the 8th of last October I visited a piece of woods in Sandusky county where there was nothing fit for an animal to eat, the principal herbs being nettle, white snake-root, poke and black nightshade, with some clearweed, basil, and bedstraw. Every plant of snake-root had been nipped off so that I did not see one more than about half the normal height. This had probably been done by cattle from the adjoining pasture which were doubtless accustomed to spending a portion of hot sunny days in the shade of the woods. A few weeks before my visit a man and his wife who had been using butter made from the milk of cows in this pasture had milk-sickness and the wife died.
>
> Elisha Haff, Townsend township, Sandusky county, did not think trembles were due to any weed, until he found that western sheep which he turned into his woods ate the white snake-root and died of trembles. Sheep whose ancestors had long been in the region did not eat it, and did not have trembles. Since that he has been destroying the weed.
>
> Mr. William Ramsdell of Bloomingville informs me that about 1842 when there was so much discussion of the subject the boys of the neighborhood used to assemble evenings at the old lime-kiln southeast of Castalia and experiment on dogs. They would boil or steep the white snake-root and putting the extract in milk give it to the dogs, in which it would induce the trembles; a large number were killed in this way. Some one experimented on sheep with the same result. He informs me also that a Mr. Redmond (who did not believe that the weed was the cause of trembles) chewed some of the weed and died after suffering for about four weeks.
>
> On November 26th my pupil, Oscar Kubach, using snake-root I had recently gathered, broke up the stems and leaves of two plants and soaked them over night in about a pint of milk, of which he gave about a gill at about 9 A. M. to his tom-cat. The cat took about one-half of it.
>
> About 9:30 it seemed to take effect and he tried very hard to vomit but could not. He took long, deep breaths. He was quiet and wanted to sleep very hard. All of a sudden he would tremble very hard, then again very little. A watery fluid passed from his eyes and mouth. He chose a spot in the sun and when driven away walked back in a staggering manner. He had no appetite. His senses seemed to be duller, as he did not care for anything. He went to sleep about 10:30 but did not sleep sound. He seemed to be in an unconscious state for the rest of the day. The next morning about 10:30 he walked about three rods and there died about noon.

Mr. Mosely estimates that 5000 animals have succumbed from the disease in a small area in northern Ohio. There are many cases commonly in this same region from milk sickness.

Dr. Albert C. Crawford of the Bureau of Plant Industry, investigated the so-called milk sickness occurring in Minooka, Illinois, which resulted in the death of about 50 head of cattle, and gives the following conclusions:

> To sum up, it certainly can not be said that it has been proved that milksickness is due to any constituent of *E. urticaefolium.* The transmission of the disease by eating small quantities of meat or milk of animals sick with the "trembles" and the fact that cooked meat or boiled milk does not produce this disorder point primarily rather to a parasitic origin, while the fact that*Eupatorium urticaefolium* is abundant in areas where the disease is not known and absent in some milksick districts also indicates that the plant has no relation to the disease. If it does, it would be only an accidental carrier of some pathogenic organism. According to reports, the same flora may be in areas in which "trembles" occur as in those free from it, and milksickness is also said to occur where no vegetation grows (inclosed pens). The disease also has disappeared from an area after simply clearing the woodland where it occurred and turning it into pasture. Again, severe epidemics have occurred in winter when the foliage has disappeared, which would tend to exclude the higher non-evergreen plants as the cause of this disorder. In fact, all the evidence in hand is against the causation of this disease by such plants, and certain analogies with cases of botulismus suggest a somewhat similar cause. If there is any truth in the statement that cattle exposed in pasture to night air especially contract the disease, this fact might suggest the more or less direcct connection of some night organism as a carrier of the parasite, and certain parasites are supposed to be associated with certain localities. Very little is known chemically of *Eupatorium urticaefolium.*

And this seems to confirm the investigation by Dr. Bitting of the Indiana Agricultural Experiment Station. It seems very doubtful that this plant causes milk sickness, since it is very common in many pastures in the west where trembles does not occur.

In regard to boneset (*E. purpureum* and *E. perfoliatum*) Dr. Johnson states as follows:

> Of domestic remedies few are better known or more largely used than boneset. It is tonic, diaphoretic, emetic, and cathartic, the different effects depending largely upon the size of the dose and mode of administration. The infusion, taken cold in moderate doses, is tonic, and is employed in debility of the digestive organs and in convalescence. Taken warm in large doses, the infusion or decoction produces copious diaphoresis, and is employed in the acute stages of catarrhal affections and in fevers, especially those of an intermittent or remittent type. In still larger doses the warm infusion or decoction produces emesis or catharsis; these effects are, however, seldom sought.
>
> *E. purpureum,* or gravel-root, is said to be diuretic and to have been employed in urinary affections, but it has not attained an established reputation and is seldom used.

Boneset (*E. perfoliatum*) contains the glucoside *eupatorin*; the *E. purpureum* contains the glucoside *euparin* $C_{12}H_{11}O_3$.

Dr. T. Holm gives an extended account of the medicinal qualities accompanied by the anatomical structure of this plant. *Eupatorium perfoliatum** according to Dr. Holm is now prescribed as a tonic and in large doses is an emetic.

9. *Trilisa* Cass. Trilisa

Erect perennial herbs, fibrous roots, leaves alternate and simple; heads in terminal corymbose panicles, discoid, 5-10-flowered, flowers white, receptacle flat; corolla regular, 5-lobed; achenes nearly terete, 10-ribbed. A small genus closely allied to Liatris. Two species native to eastern North America.

Trilisa odoratissima Cass. Vanilla Plant

A rather stout, somewhat glabrous perennial, leaves pale obovate-spatulate, or oval, thickish and clasping; head in corymbose clusters; achenes glandular pubescent.

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* Merck's Rep. XVII:326-328. f. 1-11.

Distribution. From Virginia to Louisiana.

Trilisa paniculata Cass. Hairy Trilisa

Viscid-hairy, perennial, leaves entire, base lanceolate, narrowly oblong, acute, or obtusish, those of the stem small; heads paniculate; achenes finely pubescent.

Distribution. From Virginia to Georgia and Florida.

Poisonous properties. The former plant has the odor of vanilla and contains the substance *cumarin* CHO. Dr. Johnson says:

> Odoratissima deserves much more attention from the fact that it is largely used as an adulterant of smoking tobacco, than from any demonstrated medicinal virtues. There is abundant evidence to show that the leaves of this plant enter largely into the manufacture of many grades of smoking tobacco, especially those employed in our domestic cigarettes. And the author is convinced, from personal experience and observation, that the deleterious effects produced by smoking tobacco thus adulterated are much greater than those produced by the consumption of pure tobacco in even great excess. The inhalation of a few whiffs of the smoke from a cigarette made from this adulterated material, provided the inhalations are made in quick succession, produces a train of cerebral sensations of an intoxicating character as much different from any effect of tobacco alone as could be imagined; and prolonged use of such cigarettes invariably produces great derangement of the digestive organs, very little resembling the dyspepsia induced by excessive use of tobacco, together with cardiac symptoms often of a distressing character. And again, the habit of smoking coumarin in this form appears to become more inveterate, more exacting, than that of the use of tobacco alone, so that the unhappy victim—for such he should be called—is never comfortable except when indulging. Hence it happens that cigarette-smoking in this country in its effects upon adolescents especially, is assuming the proportions of a great national evil, and is producing far more deleterious effects than in other countries where it is practised to a greater extent but with different material.

10. *Liatris* Schreb. Button Snakeroot. Blazing Star.

Perennial herb, usually from a corm-like tuber; leaves alternate entire, narrow; flowers spicate or racemose, discoid, scales of the involucre few or many imbricated in several series, the outer shorter, corolla regular, 5-lobed or 5-cleft; branches of the style exserted; achenes 10-ribbed, slender tapering to the base; flowers rose-purple, rarely paler in color.

Distribution. About 20 species in North America.

Liatris spicata (L.) Willd. Snakeroot

Smooth or somewhat hairy perennial; leafy stem; leaves linear the lower 3-5 nerved; heads crowded in a long spike, 8-12 flowered; involucre cylindrical, bell-shaped, flowers purple; pappus not very plumose.

Distribution. In moist soil from New England to Florida, Kentucky, Arkansas, and South Dakota.

Liatris pycnostachya Michx. Snakeroot

Hairy or smooth perennial with a stout stem 3-5 feet high; leaves linear-lanceolate, the upper very narrowly linear; spikes 6-20 inches long, densely flowered, flowers purple; pappus not very plumose.

Distribution. Prairies, Indiana to Minnesota and southward.

Liatris punctata Hook. Western Snakeroot

A glabrous or sparingly pubescent perennial; stout rootstock; leaves rigid punctate; spike many flowered; heads 3-6 flowered, purple; bracts of involucre oblong, often ciliate on the margins; pappus very plumose.

Distribution. From Minnesota, Western Iowa, to Montana, Texas, New Mexico and Sonora.

Poisonous properties. Several species of Liatris are powerful diaphoretics, formerly these species were used as antidotes against snake bite. Dr. Johnson says that they probably possess no antidotal properties whatever and beneficial effects attributed to them are doubtless due to the diaphoresis induced by the administration of large quantities of the hot decoction.

11. *Grindelia* Willd. Gum Weed.

Coarse perennial or biennial herbs, occasionally woody at the base; leaves alternate, sessile or clasping, spinulose serrate; involucre hemispherical; scales imbricated in several series; heads large, terminating leafy branches; radiate or rayless; ray flowers yellow, pistillate, disk flowers perfect or staminate; achenes short, thick, compressed or turgid; pappus of 8 awns, soon falling.

About 25 species, from western Minnesota and Iowa westward and southward to Peru and Chili.

Grindelia squarrosa (Pursh.). Gum Weed

A resinous, viscid, glabrous perennial from 1-3 feet high; leaves alternate, spatulate to linear oblong, sessile or clasping, spinulose serrate; heads many flowered; ray flowers yellow, pistillate; scales of the involucre hemispherical, imbricated in several rows with green tips; achenes short and thick; pappus consisting of 2 or 3 awns.

Distribution. Common west of the Missouri river from Mexico, Nevada and Texas to British America and east to Minnesota, Illinois and Missouri, occasionally naturalized eastward.

Poisonous properties. Very abundant in the west; is not liked by stock. The *G. robusta* and *G. squarrosa* are used in medicine in moderate doses to stimulate the mucous membrane and are beneficial in catarrhal affections. They are also antispasmodics. An alkaloid has been isolated from *G. robusta.* It contains *grindelin,* a bitter alkaloid, and two glucosides which resemble the saponins of Polygala.

12. *Solidago* L. Golden-rod

Perennial erect herbs, simple or branched; leaves alternate, simple, toothed or entire; heads small, in terminal or axillary panicles, cymose corymbose; ray flowers yellow, rays few or many pistillate; disk flowers yellow, perfect; involucre hemispherical or bell-shaped, bracts appressed, destitute of green tips, achenes many-ribbed, terete or nearly so; pappus of simple capillary bristles.

A genus of about 100 species mostly in North America. About one-half of the number found in northern states east of the Missouri river. A few of the species are handsome and ornamental, like *Solidago speciosa, S. Drummondii, S. Missouriensis* and *S. odora.* The latter species is used as a stimulant and carminative. From this species there is derived an aromatic oil. An oil is also derived from *Solidago canadensis,* which strongly resembles the oil obtained from pine needles. The leaves of the fragrant golden-rod (*S. odora*) are often used as a substitute for tea; it contains an aromatic volatile oil.

Solidago canadensis L. Golden-rod

A perennial with rough stem, from 3-6 feet high; leaves hairy beneath, rough above, lanceolate and pointed, sharply serrate; heads small, few flowered;

rays yellow, short pistillate; scales of the involucre appressed, not herbaceous; receptacle small, not chaffy; achenes ribbed; pappus simple, of capillary bristles.

Distribution. Widely distributed from New Brunswick to Florida. Common in the Mississippi Valley, especially along fences and in pastures and borders of fields in the Rocky Mountains to the Northwest Territory, British Columbia to Arizona.

Solidago rigida L. Rigid Golden-rod

An erect perennial from 2-5 feet high, rough and somewhat hairy, with minute pubescence; leaves oval or oblong, thick and rigid, not 3-nerved, the upper sessile, slightly serrate; heads in a compound corymb, large, 3 or more flowered; rays large, 7 to 10, yellow.

Distribution. Common in the upper Mississippi Valley, especially on the prairies; occurs east to New England.

Poisonous properties. It is thought by some that hay fever is caused by this and other species. A disease of horses in Wisconsin a few years ago was attributed to the eating of golden-rod, but Chesnut thought this might be caused by a rust fungus, *Coleosporium solidaginis.*

Mr. J. L. Scott, who made an investigation of this disease, reported in Garden and Forest as follows:

> During the past four years a large number of horses have died in the northern part of this state from the ravages of a disease which has baffled the skill of veterinarians, and I have been called upon to make investigations as to the cause and nature of the malady. At first it was thought to be anthrax, and samples of the blood and sections from the spleen and other internal organs were sent to the Bureau of Animal Industry and to Dr. Russell, of the State University, for bacteriological examination. Numerous bacteria were found, but the bacillus anthracis was not present.
>
> The horses affected were in the majority of cases heavy draught horses from the lumber camps. These animals were brought from the woods in the spring, usually in good condition, and turned out to pasture. Most of them were fed grain while on pasture. On the farm of Mr. C. F. Reynolds, Hayward, Wisconsin, over seventy horses died during the past four years from this peculiar malady. The pasture contained about four hundred acres, three hundred acres of which had been broken and seeded to timothy. Adjoining this was one hundred acres of "slashings" or land from which the timber had been cut, but which had never been broken. This was thickly covered with Golden-rod. On one side of the farm is a lake with a clean gravel bottom and shore. The lake is fed by springs. There is no marsh or low land on the farm. Upon investigation I became convinced that the cause of the trouble was to be found either in the food or water, and watched the horses closely for several days, and saw them eating the Golden-rod greedily—some of them, especially those affected, seeming to prefer the plant to anything else.
>
> I also visited the farm of Peter Traux, near Eau Claire. There is no Goldenrod to be found on this farm and the disease has not made its appearance. During the past summer, Mr. Traux placed ten horses in pasture near by, where the plant was plentiful, and eight of them died during the summer and the remaining two were affected. When the healthy horses are taken from the pasture in the fall the disease disappears. None of the animals attacked by the malady have recovered, and medicinal treatment does not seem to produce any beneficial effect.
>
> Symptoms: The animal appears dull, ears drooped, temperature elevated, ranging from 103° to 107°, Fahrenheit, during the entire course of the disease. The visible mucous membranes are pallid. On the mucous membranes of the vulva small petechial spots are seen. Occasionally the legs swell and oedematous enlargements appear under the abdomen. The appetite remains fairly good during the entire course of the disease. Emaciation takes place rapidly as the disease advances. Loss of coördination with staggering gait. Death takes place in from two weeks to two months from the onset.
>
> Post mortem: On cutting open the body the blood appears to be completely disintegrated, resembling ordinary blood serum. Intestines bloodless, with numerous petechial spots on the mucous membrane. Spleen enlarged, weighing from six to ten pounds. No structural changes.

apparent to the naked eye. The lungs and kidneys apparently normal. The brain and spinal cord were not examined.

I am fully convinced that this disease is due either to some poisonous principle in the plant or some parasitic fungus upon the surface of the same. It is now too late in the season for any investigation to be carried on in this direction this year, but I intend to have the matter thoroughly investigated next summer.

13. *Aster* (Tourn.) L. Aster

Herbs generally perennial with corymbose panicled or racemose heads; heads many flowered, radiate; the ray flowers in a single series, fertile. Bracts of the involucre more or less imbricated, generally with herbaceous tips; receptacles flat; achenes somewhat flattened; pappus simple, consisting of capillary bristles. A large genus of 275 species, chiefly in eastern North America. Flowering in the autumn. A few of the species are cultivated for ornamental purposes.

The New England aster (*A. novae-angliae*) occurs in moist ground. The *A. laevis* with somewhat clasping leaves is common in dry soil or prairie regions of the West. The small white aster (*A. multiflorus*) with small leaves is common along roadsides in dry soil. Very few of the species have deleterious properties.

Aster Parryi Gray. Parry's Aster or Woody Aster.

A somewhat hoary perennial with deep woody roots and a short more or less branched stem; hoary leaves, spatulate-linear, cuspidate; heads solitary, bracts of the involucre oblong-lanceolate, long acuminate, pubescent, rays white over half inch long, achenes white villous. This is the *Xylorhiza Parryi* Gray.

Distribution. Common in saline soils. In Colorado, West Wyoming and Utah.

Poisonous properties. This plant has recently come into prominence in western Wyoming where the disease "grub in the head" has been attributed to the plant but Dr. Aven Nelson[1] has attributed this disease to a fungus *Puccinia xylorrhizae* which according to Dr. Nelson abundantly occurs on the plant. He says:

> If it should prove to be true that the malady is due to the eating of the aster, then it may be the aster itself that is the source of the trouble, but the chances are rather better that the specific poisonous qualities are due to the fungus. Some other parasitic fungi have been proved poisonous and we may well, in the absence of evidence to the contrary, also suspect this one.

Dr. Nelson states that the trouble is not a new one and that similar outbreaks have occurred in previous years, the disease recurring in the same localities. The disease was prevalent near Medicine Bow and northward to the Shirley Basin as well as Natrona county. The farmers in the vicinity where this disease occurs speak of the area in which the plant occurs as the "poison patch." Dr. O. L. Prien, Wyoming Agricultural Station, and Dr. Frederick of the Utah Agricultural Station, are making a careful study of this disease. To prevent the trouble, sheep should be kept, so far as possible, away from areas in which this plant occurs.

14. *Erigeron* L. Fleabane, Daisy

Branching or scapose herbs with entire or toothed leaves; heads in corymbose, paniculate or solitary peduncled heads; scales of the involucre narrow, nearly equal, not foliaceous or green-tipped; flowers radiate, white violet or purple, numerous, fertile; disk flowers yellow, tubular and perfect; branches of the style more or less flattened with short appendages; achenes pubescent and 2-nerved; pappus a single row of fine capillary bristles.

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[1] Press Bull. Wyoming Agr. Exp. Sta. No. 10.

About 120 species of wide distribution, most numerous in North America. Several species of fleabane (*E. philadelphicus, E. annuus* and *E. canadensis*) are used in medicine. They are reputed diuretics, tonics and astringents.

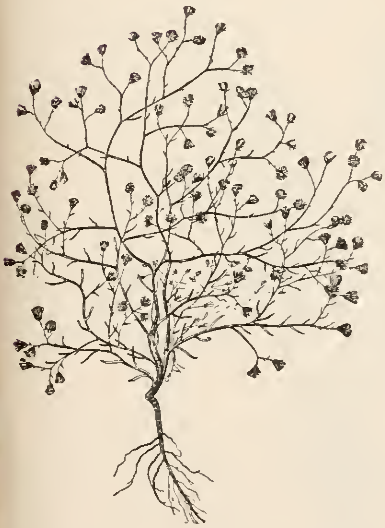

Fig. A. Small Horseweed (*Erigeron divaricatus*). From Indiana to Minnesota to Nebraska and southward. Common in sterile grounds. (Charlotte M. King).

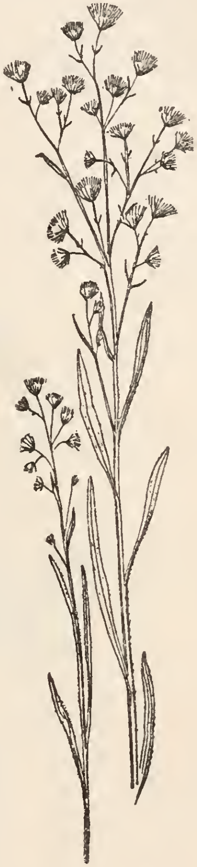

Fig. B. Horseweed, Mares' Tail (*Erigeron canadensis*). A common weed throughout the United States, especially northward, also in Europe. Acrid said to be irritating. (Charlotte M. King).

Erigeron canadensis L. Horseweed

Bristly herb, stem hairy or somewhat glabrate, 1-6 feet high, simple or paniculately branched; leaves usually pubescent or ciliate, the lower spatulate, incised or entire, obtuse or acutish, the upper generally linear and entire; heads numerous, with inconspicuous white ray flowers shorter than the pappus; achenes small, flattened; pappus of numerous small fragile bristles.

Distribution. Common throughout the eastern part of North America except far northward. Common also in the Rocky Mountain region, and in waste and cultivated grounds along the Pacific coast appearing as an introduced weed. Also an introduced weed in Europe and South America.

Erigeron ramosus (Walt.) BSP. White Weed. Fleabane.

Stem and leaves somewhat hirsute and hairy, roughish; leaves entire or nearly so; the upper lanceolate, the lower oblong or spatulate; heads borne in corymbose panicles; ray flowers white and twice as long as the scales of the involucre; achenes small, pappus double, the inner of fragile bristles.

Distribution. From Nova Scotia to Florida, west to Louisiana and Texas to Northwest Territory.

Erigeron annuus (L.) Pers. Fleabane. White Weed.

A sparingly pubescent annual from 3-5 feet high; leaves thin, coarsely and sharply toothed, the lower one ovate, or ovate-lanceolate, acute and entire on both ends; heads corymbed and rays white, tinged with purple.

Distribution. A common weed in meadows, pastures and woods in northern United States.

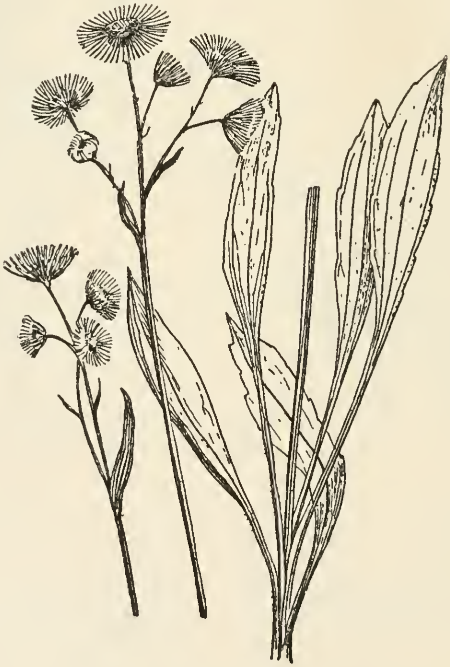

Fig. C. White weed (*Erigeron annuus*). Common in clover and timothy meadows. A troublesome weed. Leaves and stem with a somewhat bitter flavor. (Charlotte M. King).

Poisonous properties. Common horseweed (*E. canadensis*) abundant in many places has been looked upon as being suspicious. It contains an oil, mainly a terpene $C_{10}H_{10}$. It has an acrid taste and is neutral in its reaction. It causes smarting of the eyes, soreness of the throat, aching of extremities, and colic. It causes irritation to people handling the plant. When in hay it may be injurious because the leaves are very bitter and cause much dust. The other species are very abundant in meadows in central Mississippi Valley states, and are regarded with much disfavor.

15. *Rudbeckia* L. Cone-flowers

Annual, biennial or perennial herbs, usually rough or rarely smooth, with alternate leaves; flowers in terminal clusters; involucre hemispherical; bracts imbricated in 2-4 series; scales leaf-like, in 2 rows, spreading; receptacle conical or columnar with chaffy scales; ray flowers neutral; disk flowers perfect, fertile; achenes 4-angled, obtuse or truncate at the apex; pappus wanting or a minute crown.

A small genus of some 30 species in North America and Mexico. Several species are common in cultivation.

Rudbeckia hirta L. Cone-flower. Nigger-head

A rough, bristly, hairy biennial from 1-2½ feet high with stems simple or branched near the base, bearing a long pedunculate head; leaves nearly entire, the upper sessile, oblong or lanceolate, the lower petioled and spatulate; heads many-flowered, radiate, the rays about 14, neutral; receptacle columnar or conical; chaff hairy at tip, acutish; ray flowers yellow, disk dull brown; achenes four-angled; pappus none.

Distribution. Common in dry soils and on the prairies and meadows in the northern Mississippi Valley, also a common weed in meadows in the eastern states. Introduced largely with clover seed.

Rudbeckia laciniata L. Golden Glow or Tall Cone-flower.

A tall branching smooth perennial; leaves thin, minutely pubescent; the upper leaves irregular; ray flowers yellow; disk flowers dull greenish; bracts of the involucre unequal; pappus a short crown. Improved forms of this species are cultivated under the name of golden glow.

Distribution. From Canada to Florida, Kentucky, Kansas and New Mexico to Manitoba and Montana.

Rudbeckia occidentalis Nutt. Western Cone-flower

Nearly glabrous and smooth, or somewhat scabrous-puberulent; leaves undivided, ovate or ovate-lanceolate, acuminate, entire or irregularly and sparingly dentate, 4-8 inches long; upper sessile by a rounded or subcordate base; lower abruptly contracted into a short winged petiole, rarely a pair of obscure lateral lobes; disk in age becoming 1½ inches long, and achenes 2 lines long.

Distribution. Common in the Rocky Mountains from Utah, Wyoming and Idaho.

Poisonous properties. Dr. Schaffner states that the *R. laciniata* is poisonous to sheep. It is eaten by cattle. The *R. occidentalis* is eaten by sheep but not relished. May be suspicious. A correspondent in Kansas and one in Iowa state that the plant is poisonous to cattle.

16. *Bidens* L. Bur Marigold or Beggar-ticks

Annual or perennial herbs with opposite leaves or the upper alternate; involucre double, campanulate, the outer scales commonly foliaceous; heads many-flowered; receptacle chaffy; rays present or absent; when present, neutral, in our species yellow; disk flowers perfect, fertile; achenes flattened or 4-sided; pappus of 2-6 teeth, upwardly or downwardly barbed.

About 70 species of wide distribution.

Bidens discoidea (T. & G.) Britton. Small Tickseed

A diffusely branched annual from 1-2 feet high; leaves petioled, ternately divided, leaflets ovate-lanceolate, pointed and serrate; rays wanting; disk flowers yellow; achenes narrow wedge-shaped, bearing a pair of short and stout upwardly or downwardly barbed awns.

Distribution. Common on wet banks throughout the northern Mississippi Valley.

Bidens frondosa L. Beggar-ticks. Stick-tights.

A branching hairy or smooth annual from 2-6 feet high; leaves petioled, 3-5 divided, the stalked leaflets lanceolate, pointed, coarsely toothed; rays small and yellow; involucre double, the outer foliaceous, longer than the head; receptacle flattish with deciduous chaff; achenes wedge-obovate, 2-awned, the awns downwardly barbed.

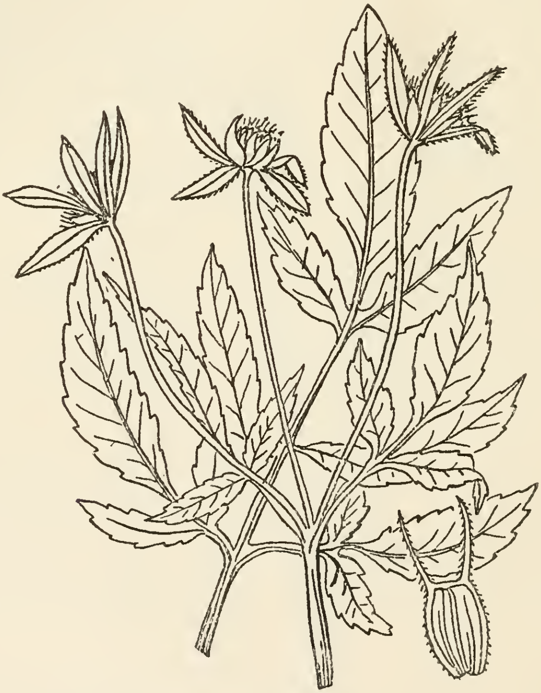

Fig. 447a. Spanish Needle, Boot Jacks (*Bidens frondosa*). The flattened achenes with downwardly barbed arms more or less irritating. (Charlotte M. King).

Distribution. Widely distributed in moist places throughout the northern states; often a very troublesome weed in gardens. Widely scattered because of the "seeds" adhering to clothing, pelts of animals, etc.

Bidens bipinnata L. Spanish Needle

A smooth branched annual from 1-5 feet high; leaves petioled and 1-3 pinnately dissected; heads many flowered, small, long peduncled; involucre double, outer of linear scales: ray flowers yellow or none; achenes linear, 4-angled, narrowed upward into a beak, nearly smooth, the four downwardly barbed awns usually spreading, shorter than the achenes.

Distribution. Native to Mexico and tropical America and the southern states, now occurring as far north as Rhode Island to Ohio, southern Iowa and Nebraska. A weed also in southern Europe and Asia.

Poisonous properties. All of the species are local irritants but especially *B. frondosa.*

17. *Helenium* L. Sneeze-weed.

Erect branching annual or perennial herbs; plants often sprinkled with resinous matter; leaves alternate decurrent on the stem; branches terminated by a single or corymbose heads, yellow or purple in color; involucre short and broad but small; bracts in 1 or 2 series, linear or subulate reflexed or spreading; ray flowers pistillate and fertile or neutral, rays 3-5 cleft; disk flowers perfect, fertile, corolla 4-5 toothed; style branches dilated and truncate at the apex; achenes top-shaped and ribbed; pappus of 5-8 thin 1-nerved chaffy scales extended into a point.

About 25 species in North America. All of the species of the genus more or less poisonous. Among these are the *H. Bigelovii* of Oregon, California, and *H. nudiflorum* from Texas to Kansas, Illinois and Florida.

Helenium Hoopesii Gray

A stout perennial from 1-2 feet high, tomentose or pubescent, when young becoming smooth with age; leaves rather thick, entire oblong lanceolate, the lower spatulate and tapering base, somewhat nerved; heads large, single or several; ray flowers fertile, yellow, an inch long; soon reflexed; bracts of the involucre in 2 series.

Distribution. Common in the Rocky Mountains to eastern Oregon to California. It covers large stretches between 6,000 and 8,000 feet in the Uintah mountains.

Poisonous nature. It is said to be poisonous like other species of the genus. Sheep carefully avoid it, feeding on the grass and other herbaceous plants, leaving the plant standing.

Helenium autumnale L. Sneeze-weed

A smooth or pubescent perennial from 1-6 feet high; leaves toothed, lanceolate to obovate, oblong decurrent on the stem, acuminate at the apex; heads numerous, many flowered; radiate; rays yellow, wedge shaped, 3-5 cleft, fertile; disk flowers yellow, involucre small, reflexed; scales linear or awl-shaped; receptacle glabrous or oblong; achenes pubescent on the angles; scales of the pappus ovate or acuminate; the variety *grandiflorum* with larger heads; scales of the pappus narrowed and longer awned.

Distribution. Common in low meadows and alluvial banks from eastern Canada to South Dakota, Florida to Alabama, and especially common in the northern Mississippi Valley to Kansas. Occurs also in the Rocky Mountains, Wyoming to Montana. The variety in Washington to California.

Poisonous properties. This plant is considered poisonous to cattle and sheep. Numerous complaints have been made in various parts of the state of Iowa in regard to the poisonous nature of this weed. This plant is more or less bitter, acrid and pungent, especially the flowers. Parts of the plant rubbed were used by the Winnebago Indians for colds and to produce sneezing. Dr. Chesnut says:

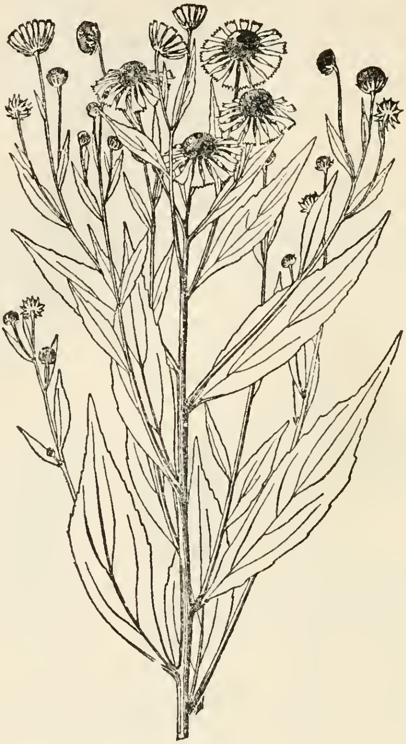

Fig. 448. Sneeze-weed (*Helenium autumnale*).

> Sheep, cattle and horses that are unfamiliar with the plant are often poisoned by it when driven to localities where it is abundant. As a rule these animals avoid it, but it is said they sometimes develop a taste for it and are quickly killed by eating it in large quantity. The poisonous constituent has not been closely investigated, but it is known that it exists principally in the flowers. The young plants appear to be only very slightly dangerous. In the mature ones the amount of poison present seems to vary greatly even in the same field. The symptoms as determined by experiments made in Mississippi upon calves, are an accelerated pulse, difficult breathing, staggering, and extreme sensitiveness to the touch. In fatal cases, death is preceded by spasms and convulsions.

Melted lard, when given before the spasms begin, has been used with good effect in offsetting the action of the poison. The sneeze weeds are said sometimes to taint milk, imparting to it a bitter flavor.

Dr. Phares, in an early account of the poisonous nature of the plant states:

> Experiment 1.—Calf about four months old and not fed in the morning. Upon three ounces of the dried plant was poured a pint of boiling water. After an hour the water was decanted with pressure. Mr. J. W. McWilliams, of the senior class, gave all the doses in all the experiments and noted the symptoms. October 6th the above infusion was ordered to be divided into four parts and one part given every half hour, beginning at 11:10 a. m. The first dose produced no very marked effect—only a flow of a few tears. After second dose became restless, later laid down. After third dose breathing impaired, continued lying down and appears sicker for a short while. Fourth dose, breathing harder,

but at 3 p. m. the calf was resting easy. Next day he seemed to be nearly as well as usual and took his feed.

Experiment 2.—October 13th; same calf. A hot infusion of six ounces of the drug was prepared in one quart of water and given between 8 a. m. and noon. Soon after the first dose some weeping began, but no other marked effect was observed. After second dose the calf laid down. Third dose, he continues down, but somewhat restless and sick. Fourth dose, becomes very restless, bowels loose, staggering, and very sick, holding head down, sucking wind, left flank tympanitic but not very tense, right flank contracted, trying to put head between forelegs, and very sick greater part of the day; movements weak and uncertain, purposeless, hyperesthesia very marked, especially along the back, shrinking from least touch, but by persistent handling submits to touch, respiration and pulse quickened, appearance of slight spasm along the back, neither eats nor drinks of food and water and milk in his stall, a little straw from floor in his mouth, and although the jaw is in constant motion the straw is undisturbed and he seems unconscious of its presence. Next day apparently well.

Experiment 3.—October 20th; another calf about four months old. One pound of the dry plant was taken, one gallon water poured on it and boiled down to a quart; all given by 10:35 a. m. After third dose the left flank tympanitic, feces and urine discharged, slight jerking as though chilled, tremor of muscles of hindquarters, lying on right side over an hour, breathes with some noise and distress, very sensitive from withers to sacrum; at 11 o'clock fullness of left flank subsided, limbs showed weakness and later stiffness, very sick, frothing at mouth and flow from nose. Next day the calf was well.

The large quantity of the drug given this calf producing little more effect than the smaller dose on the former one leads me to suppose that the prolonged boiling may have dissipated a portion of the poisonous principle. Knowing that none of the symptoms observed would lead on to death no antidote was administered in any of the experiments. The weeping and movtment of the jaw were probably due to the pungent effect of the drug on the throat and stomach; and I incline to the opinion that the nervous symptoms were not caused by direct action of the drug on nerve centers, but were reflexes for the irritated throat and stomach.

In the sheep the spasms in severe cases are epileptiform and a sheep may have many such convulsions and yet recover without treatment and after many hours rise up and walk.

The horse and mule succumbed to the injurious effects of the poison quicker and more completely than other animals. The effect is manifested very soon after ingestion and with great violence. The animal cannot control his motions, plunges about blindly, falls dead or perhaps breaks his neck in falling forward with the head under the body.

An antidote which has proved effective is a pint or two of melted lard poured down the animal's throat. The relief is very prompt. But it must be given before the horse loses control of his limbs, or it cannot be administered at all. The relief is so prompt and complete that it is difficult to believe that it is the direct effect of the lard on the nerve centers, but as a local emollient applied directly to the burning throat and stomach. The local trouble being quickly relieved, the violent reflex effect on the nervous system suddenly ceases.

When we consider the wide distribution of this plant and that in some places it is so abundant as to hide the earth from view over whole acres, it is remarkable that so few poisonings occur. But animals have no special fondness for it. When they have been long on the road and deprived of green food, stopping where this weed is found and other green plants scarce, they are disposed to eat a little of it. It is under such conditions that the plant is most frequently eaten and the poisoning occurs.

Animals, notably sheep, once intoxicated by the plant and recovering, seem to acquire a mania for it, and when finding themselves in localities where it grows hurry to and devour it.

Within 200 miles of the Gulf of Mexico the *H. quadridentatum* takes the place of the preceding, is very abundant, harmless, blooms early and dies by August.

Helenium tenuifolium Nutt. Narrow-leafed Sneeze-weed.

A perennial, erect branching herb from 1½-2½ feet high; leaves alternate decurrent on the stem, linear filiform; flowers borne in corymbed clusters; heads many flowered, ray flowers yellow, fertile, disk-shaped, ribbed; pappus of 1-nerved chaffy scales, the nerve extended into a point.

Distribution. Common from Texas to Missouri, Florida and Virginia, especially in pastures and meadows and along roadsides. It is said to have been widely scattered in the south after the war of the rebellion.

Poisonous properties. It is often the cause of bitter milk in the south. Dr. Chesnut says:

> The fine-leaved Sneezeweed has been reported from several of the Gulf States, where it is a troublesome weed, fatal to horses and mules. It is not known to what extent cattle may feed on the plant with impunity, but the bitter principle in milk and meat sometimes met with in the Southern States is quite generally supposed to be due to these plants.

It contains a narcotic poison.

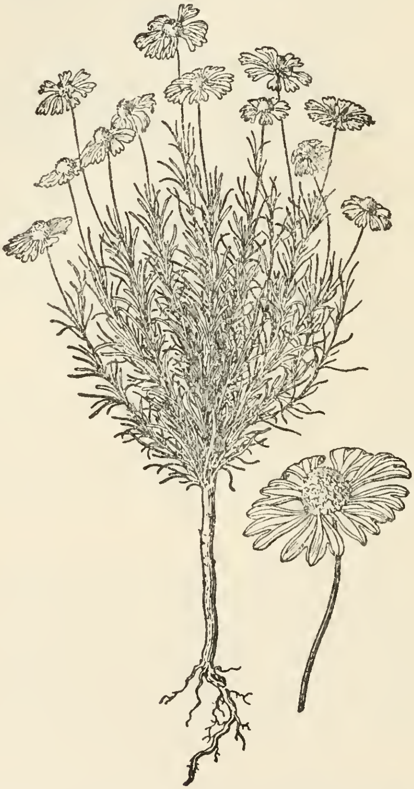

Fig. 449. Fine-leaved sneezeweed (*Helenium tenuifolium*). Often the cause of "bitter-milk" (Dewey, U. S. Dept. Agr.)

18. *Dyssodia* Lag. Fetid Marigold

Mostly annual or biennial herbs with strong scent, dotted with large pellucid glands; leaves mostly finely dissected; heads many-flowered, small, of both tubular and ray flowers; involucre cylindrical or hemispherical, bracts in one series united into a cup; receptacle flat, not chaffy, but with short bristles; ray flowers pistillate, short; disk flowers perfect; achenes slender, 4-angled; pappus a row of chaffy scales dissected into rough bristles. A single species.

Dyssodia papposa (Vent.) Hitchc. Fetid Marigold.

A nearly smooth branched annual from 6 inches-2 feet high; leaves opposite, sessile, pinnately parted, bristly-toothed with large pellucid glands, which give to the plant a strong odor. Heads many-flowered; rays small, yellow, pistillate; disk yellow; involucre with a few scales at the base, one row of scales united to form a cup; achenes slender, 4-angled, pappus a row of chaffy scales finely divided into numerous rough bristles .

Distribution. Common from western Iowa and Minnesota to Illinois and the southwest. In this section of the country it occupies the same ground occupied by the Mayweed.

Poisonous properties. It is a very disagreeable smelling herb. Not relished by stock. It is probably injurious.

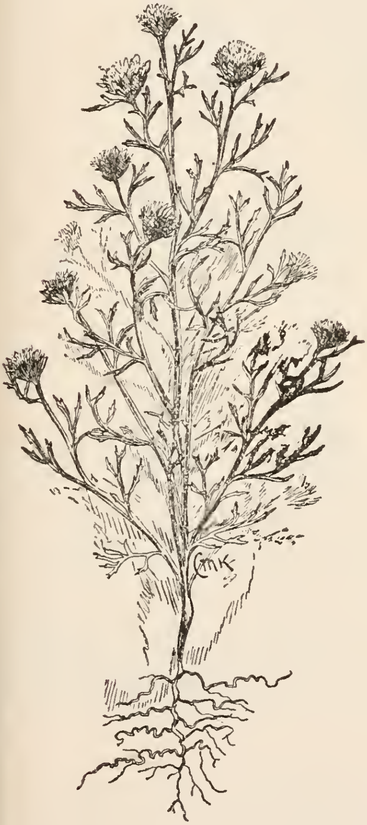

Fig. 450. Fetid Marigold (*Dyssodia papposa*). Pungent odor said to be injurious. (Charlotte M. King.)

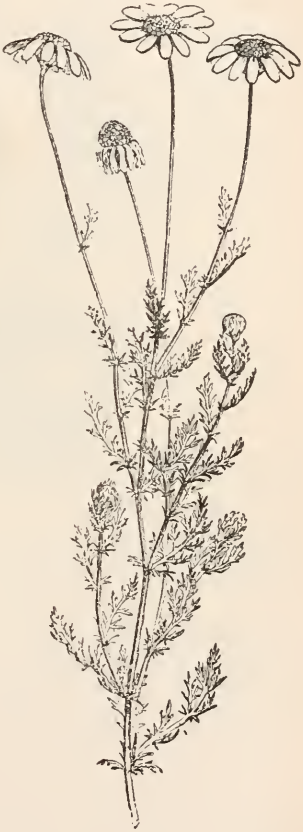

Fig. 451. Dog Fennel (*Anthemis Cotula*). Contains a pungent principle.

19. *Achillea* (Vaill.) L. Yarrow

Perennial herbs with erect leafy stems and finely dissected alternate leaves; heads many flowered, radiate, in corymbose clusters, ray flowers few, white or pink; disk flowers perfect, fertile; corollas yellow and 5-lobed; receptacle nearly flat; achenes oblong or obovate, slightly compressed; pappus wanting.

About 75 species mostly of the Old World. The yarrow (*Achillea Ptarmica*) occasionally cultivated.

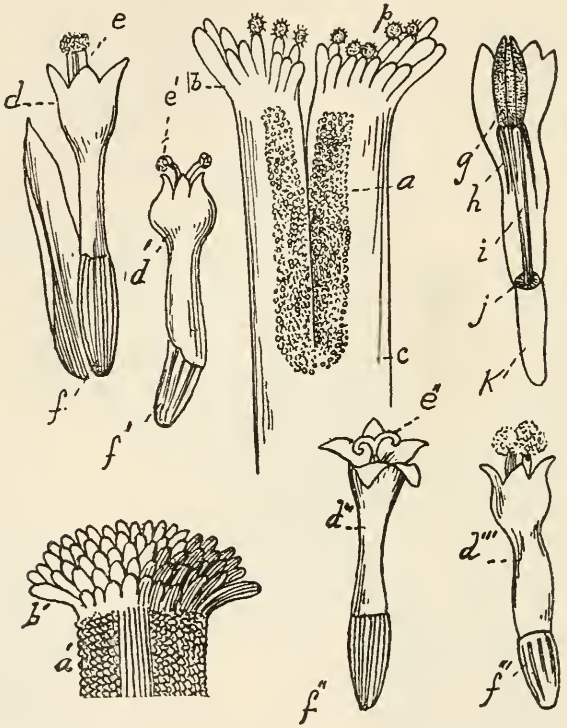

Fig. 451. Yarrow (*Achillea Millefolium*). Structure of flower. a, stigmas; b, papillae; c, style, pollen; d, single flower; e, f, g and f, flowers in different stages. (Müller).

Achillea Millefolium L. Yarrow.

Perennial herb from 1-2 feet high; simple stems; leaves twice pinnately parted, consisting of crowded linear divisions; flowers in compound flat-topped corymbs; heads many-flowered, radiate; rays 4-5, white; scales of the involucre with scarious margins; receptacles chaffy; disk flowers small, tubular; achenes oblong, flattened; pappus none.

Distribution. A common weed from the Atlantic to the Pacific. In the East it is found in old fields and dry hills and is abundant in open parks and rocky dry soils in the Rocky Mountains up to the timber line. It is native also to Europe, where it is used as an ornamental plant. Sheep will eat the weed. The form with rose-colored ray flowers is frequently cultivated.

Poisonous properties. The alkaloid *achillein* $C_{30}H_{38}N_2O_{15}$ has been isolated from the plant. Millspaugh describes the action of the drug as follows: "Yarrow seems to have a decided action upon the blood vessels, especially in the pelvis. It has been proven to be of great utility in controlling hemorrhages, especially of the pelvis, viscera, where hemorrhage is caused by it. Its common

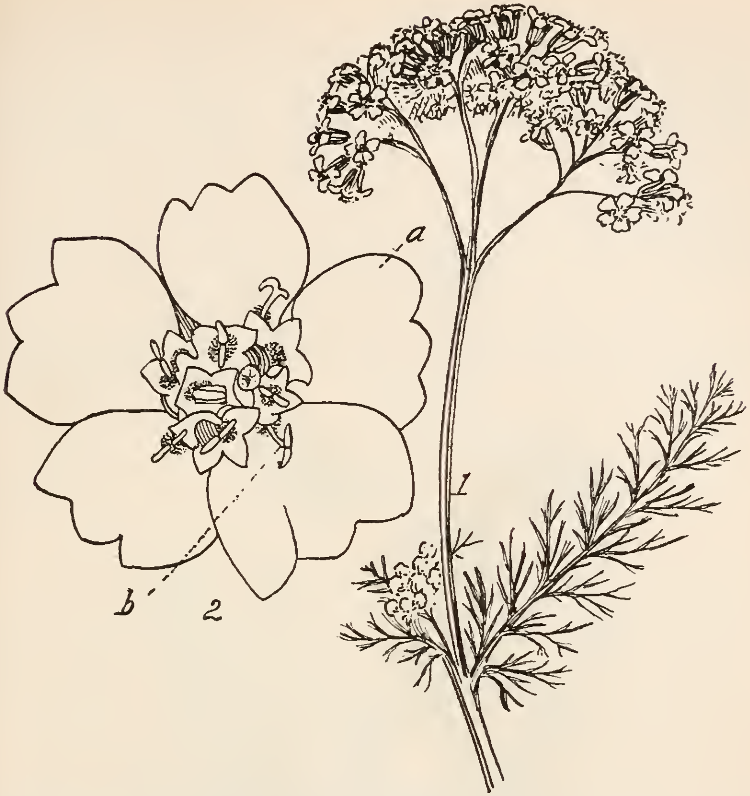

Fig. 451a. Yarrow (*Achillea Millefolium*). 1, plant with leaf and flowers. 2, A single head; a, ray flowers; b, a single flower. (Charlotte M. King).

European name, Nosebleed, was given from the fact that the early writers claimed hemorrhage of the nose followed placing its leaves in the nostrils; this may have been either due to its direct irritation, or the use of *Achillea Ptarmica,* its leaves being very sharply serrate and appressed-toothed. *Millefolium* causes burning and raw sensations of the membranes with which it comes in contact, considerable pain in the gastric and abdominal regions, with diarrhoea and enuresis. An alkaloid having the same formula as *achillein* has been isolated in *A. moschata*; a second alkaloid, *moschatin,* $C_{21}H_{27}NO_7$ is said to occur in the same plant. In Europe sometimes regarded as a forage plant.

20. *Anthemis* (Mich.) L. Mayweed

Annual or perennial herbs with finely dissected leaves and a strong scent; heads peduncled; involucre hemispherical; bracts imbricated in several series; ray flowers white or yellow, 2-3 toothed; pistillate and fertile; style branches of the disk flowers truncate; achenes oblong angled, ribbed; pappus none or short crown. There are about 60 species in the Old World. They are strong scented or aromatic herbs.

Anthemis Cotula. L. Mayweed. Dog Fennel

An acrid branching scented annual from 1-2 feet high; leaves thrice pinnately dissected; heads solitary, many flowered; ray flowers white, pistillate, fertile or neutral; involucre of numerous small imbricated dry and scarious scales; disk flowers yellow, small, tubular; achenes terete or ribbed, smooth, truncate; pappus none or a minute crown.

Distribution. A common weed in Europe where it is a native. Widely scattered in the Northern States from the Atlantic to the Dakotas and Nebraska. Occurs also in Washington and Oregon. In the north Mayweed is common in yards and along roadsides.

Poisonous properties. The strong odor and acrid taste makes it extremely undesirable for stock. The Mayweed blisters the skin.

Anthemis arvensis L. Corn Chamomile

A much branched annual or biennial pubescent herb, not ill-smelling; leaves sessile, finely 1-2 pinnately parted, less divided than the preceding; heads numerous; bracts of the involucre oblong, obtuse, usually somewhat pubescent with broad scarious margins; ray flowers white, pistillate, mostly 2-toothed; chaff of the receptacle obtuse; achenes oblong, obtusely 4-angled; pappus a small border.

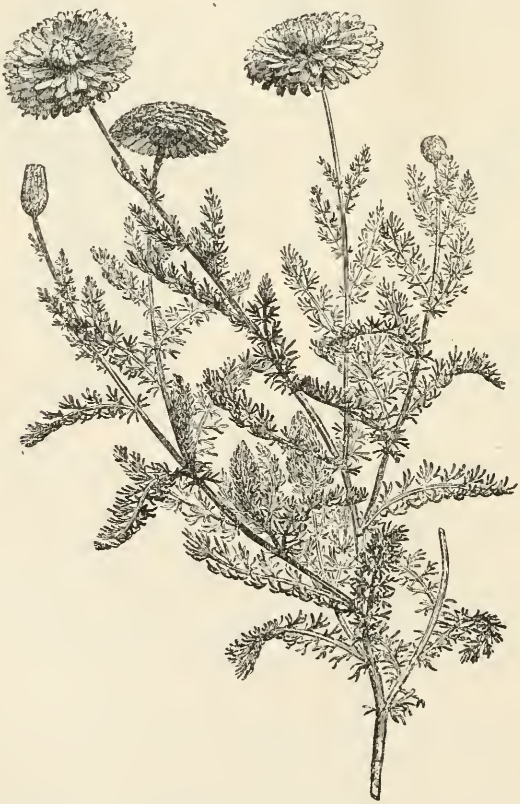

Fig. 452. *Anthemis nobilis.* Cultivated as an ornamental plant. Faguet.

Distribution. In fields and waste places in the Eastern States. Nova Scotia to Virginia, Missouri, and Wisconsin to the Pacific coast.

Poisonous properties. The oil of *Anthemis nobilis* contains the terpene *anthemin* $C_{18}H_{36}$, *angelic acid* $C_5H_8O_2$, *tiglinic acid* $C_5H_8O_2$ The oil produces abdominal pain, increase of heart action and freeness of the bowels. It is not known that our species is poisonous but stock carefully avoid the plant.

21. *Chrysanthemum* (Tourn.) L. Ox-eye Daisy

Perennial or annual herbs; leaves alternate, dentate, pinnatifid or dissected; heads single or corymbose, or both ray and tubular flowers rarely wanting; involucre with broad imbricated scales; receptacle flat or convex; ray flowers pistillate and fertile, the rays white; style, branches of the pistillate flowers, truncate and penicillate; achenes angled ar terete, striate with pappus.

About 100 species of wide distribution. The common fever-few (*Chrysanthemum Parthenium*) is frequently cultivated in Germany and is rarely an escape in eastern North America. It contains the oil of feverfew.

Insect powders are derived from several species of *Chrysanthemum*, the Dalmatian from *C. cinerariifolium* cultivated in Europe, North Africa, New York and California; the *C. coccineum* Willd. and *C. Marshallii,* found in the region of the Caucasus, furnish the Persian insect powders.

Chrysanthemum Leucanthemum L. Ox-eye Daisy

A perennial herb with erect stem and spatulate, petioled root leaves, those of the stem partly clasping; all the leaves cut or pinnatifid toothed; the nearly simple stem bears a large many-flowered head with numerous white rays, scales of the involucre with scarious margins; disk and ray flowers pistillate and fertile; achenes marked with longitudinal lines, pappus absent.

Distribution. Common in fields and meadows of the eastern states and eastern Canada, less common in the middle and western states.

Poisonous properties. This abundant weed probably contains an active principle. The *C. coccineum* contains the alkaloid *chrysanthemin* $C_{14}H_{28}N_2O_3$. The flowers are more or less irritating.

22. *Tanacetum* L. Tansy

Bitter acrid strong-scented aromatic annual or perennial herbs; leaves alternate, 1-3 pinnately dissected and corymbed heads; involucre hemispherical, depressed, scales imbricated into several series; rays wanting or present, yellow marginal flowers pistillate and fertile; corollas 5-toothed; style branches truncate and penicillate; achenes angled or ribbed; pappus a short crown. A small genus of 35 species, natives of the northern hemisphere. The *Tanacetum balsamita* contains a balsamic oil.

Tanacetum vulgare L. Tansy

A bitter acrid strong scented simple or branched perennial herb from 2-4 feet high; leaves pinnately divided into linear pinnatifid divisions, lobes serrate; heads corymbose, many flowered; ray flowers few, disk flowers yellow; marginal flowers fertile, scales of the involucre imbricated in several series; receptacle flat or convex, naked; branches of the style brush-like at the summit; achenes 5-angled or 5-ribbed, truncate or obtuse; pappus none or a short crown.

Distribution. Native to Europe, frequently escaped from gardens to roadsides along the Atlantic Coast as far west as Iowa and Kansas.

Poisonous properties. The oil of tansy is obtained from this plant. The bulk of the oil consists of *tanaceton* or *thujon* $C_{10}H_{15}(OH)$. This oil has been used as an anthelmintic since the middle ages. Tansy is a very poisonous, producing a condition similar to rabies. From this plant many serious cases of poisoning in the human race occur, but poisoning of animals is very infrequent. It is an irritant narcotic poison. Dr. Millspaugh cites a few cases as follows:

A young woman had been in the habit of using tansy tea, made from the herb, at nearly every menstrual period, for difficult menstruation. On this occasion about two and a half drachms of the oil was poured into half an ordinary tin cupful of water; this, with the exception of a small portion of the water containing about one-half drachm of the oil, was taken at one dose. Convulsions were almost at once produced, and when Dr. Bailey was sent for the patient was unconscious, foaming at the mouth, and in violent tonic spasms, with dilated pupils, frequent and feeble pulse. Constant kneading on the stomach had produced partial emesis, and then ipecac, mustard, and large draughts of hot water, emptied the stomach. Two drachms of magnesia were then given, and a full dose of acetate of morphine; consciousness then returned, no unfavorable symptoms followed, and, after thirty-six hours, without additional medication she was entirely restored.

A woman took half an ounce of the oil; the most violent rigid kind of clonic spasms occurred once in about twelve minutes, coming on generally and instantly, and continuing about one minute. They were attended with slight, if any motion of the arms; it might be called a trembling. The arms were peculiarly affected, and invariably in the same way; they were thrown out forward of, and at right angles with, the body; the hands at the wrists bent at right angles with the fore-arm supinated, the points of the fingers nearly in contact, the fingers straight and slightly bent at the metatarso-phalangeal joints. The muscles of respiration were strongly affected during each paroxysm; the air was forced from the chest slowly but steadily, and made a slight hissing noise as it escaped from between the patient's lips. During the intermission of spasm, the muscles were perfectly flexible, and the transition seemed very sudden. The jaws were the only exception to this rule; they were, for the first hour and a quarter, rigidly closed, and were with difficulty opened, but after that they were subjected to the same action as the rest of the body—when the spasms were on they were rigid; when off, they were relaxed. After the patient grew weaker, the spasms were more frequent, but had about the same severity and length. Death ensued in two hours.

On animals the symptoms are as follows according to a statement condensed by Dr. Millspaugh:

Dr. Ely Van DeWarker records cases of the action of the oil upon dogs. In one case two drachms were given, causing salivation, vomiting, dilation of the pupils, muscular twitchings, followed by clonic spasms, and a cataleptic condition from which the animal recovered. Recovery also followed a half ounce after the same class of symptoms, but, however, on repeating the dose, the already poisoned animal was plunged into a long and fatal convulsion. Postmortem examination disclosed the cerebral veins and spinal cord itself highly congested, and serous effusions had taken place in the pia mater. The lungs were found to be engorged, the left heart empty, and the right distended with dark, liquid blood. Congestion of the kidneys had also taken place, and the bladder was found contracted.

The safe maximum dose of the oil is indeterminable, a few drops only sometimes proving serious.

The symptoms occurring in a number of cases of poisoning and experiments were substantially as follows: Mental confusion, loss of consciousness; vertigo, with cephalalgia, at first contraction, then wide dilation, of the pupils, staring, immovable eye-balls; ringing in the ears; face congested; roughness of the mouth and throat; difficult deglutition; eructations, nausea, free vomiting, and burning of the stomach; sharp colic pains in the abdomen; diarrhoea; constant desire to urinate—urine at first suppressed, then profuse; respiration hurried and laborious; pulse at first high, then very low and irregular; numbness of the extremities; tonic and clonic spasms, and nervous tremblings; drowsiness and cold sweat. Death appears to ensue from a paralysis of the heart and lungs.

23. *Artemisia* L. Wormwood, Sage Brush

Bitter and aromatic herbs or shrubs with alternate leaves; heads discoid, few or many flowered, collected in panicles, racemes or spikes, with greenish or yellow flowers; involucre ovoid or oblong, scales imbricated, the outer shorter; receptacle small, naked; marginal flowers pistillate, disk perfect, or

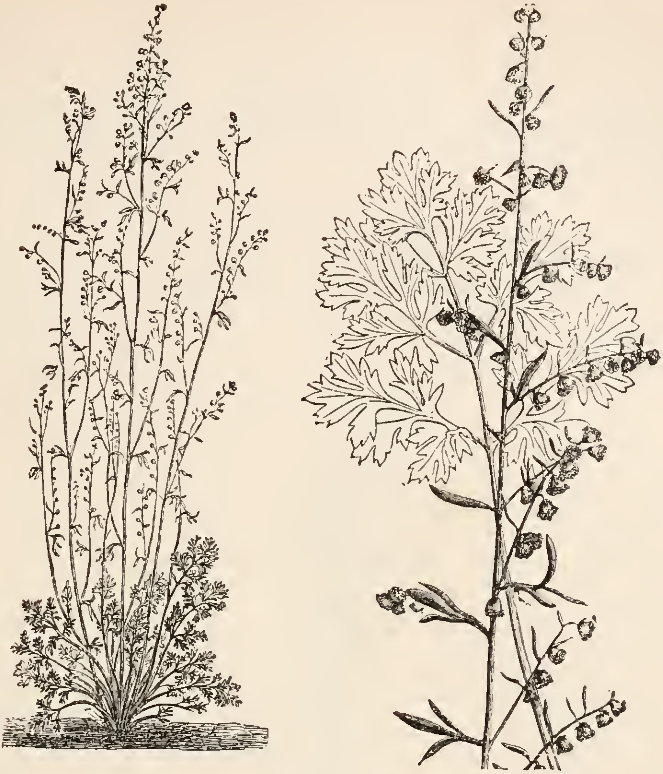

Fig. 453. *Artemisia.* Sage Brush. Absinthe and Wormwood belong to this genius. (After Faguet).

perfect and fertile with branches of the style truncate or sometimes sterile with ovaries abortive; styles undivided; marginal flowers usually pistillate and fertile, or flowers all perfect and fertile in some species; anthers often tipped with subulate appendages; achenes obovoid and no pappus.

About 200 species, mostly native of the northern hemisphere. A few in southern South America. The oil of Levant wormseed (*A. maritima* var. *Stechmanniana*) contains the substance *cineol. Santonin* $C_{15}H_{78}O_3$ is the active principle found in the flowers of *A. cana.* The *A. maritima* contains *artemisin* $C_{15}H_{18}O_4$. Absinthe is furnished by *Artemisia absinthium* of Europe. The *A. Barrelieri* furnishes the Algerian absinthe. Several species of sagebrush (*Artemisia tridentata* and *A. cana*) are common in the west and much used as forage for sheep. The alkaloid *abrotanin* $C_{21}H_{22}N_2O$ is obtained from *A. Abrotanum.*

Artemisia biennis Willd. Wormwood

An aromatic, somewhat bitter, smooth annual or biennial, from 1-3 feet high, with leafy stems and erect branches; lower leaves twice pinnately parted, the upper pinnatifid; the lobes linear or linear-oblong, serrate or cut-toothed; ray flowers absent; heads numerous in short axillary spikes; the bracts of the involucre green, scarious, margined.

Distribution. Common in the northern Mississippi Valley, now widely scattered east to Nova Scotia and south to Kentucky.

Artemisia tridentata Nutt.

From 2-12 feet high, much branched, silvery canescent; leaves cuneate, obtusely 3-toothed or 3-lobed, or 4-7 toothed at the summit, upper leaves cuneate-linear; heads homogamous; flowers all perfect and fertile; heads densely paniculate; 5-8 flowers.

Distribution. From Montana and Colorado westward covering immense areas. The characteristic sage brush; similar species are the *A. trifida,* Nutt, a smaller plant common westward, and the *A. arbuscula,* Nutt., also a dwarf plant found in the high mountains and elevated plains; the *A. cana,* Pursh, from 1-2 feet high; silvery canescent leaves; found from Saskatchewan to Dakota, Montana and Colorado.

Poisonous properties. The sage brush is consumed by sheep and cattle,

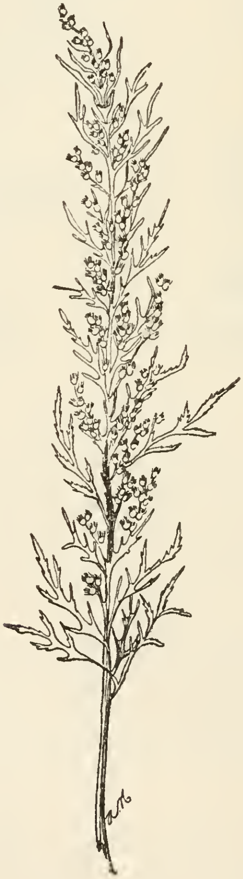

Fig. 454. Wormwood. (*Artemisia biennis*). A common weed in the Mississippi Valley. Ada Hayden.

although the latter do not relish the plant. The inhalation of the dried powder of the plant causes violent sneezing. Chesnut and Wilcox, in speaking of the sage brush of Montana, say that some species are recognized by stockmen as valuable forage plants for the late fall and winter grazing. Various species are suspected in Montana of being poisonous to stock, but no specific cases have been reported to the department. At Toston in May, 1900, it was noticed that the terminal branchlets of *A. tridentata* had all been eaten off from a considerable number of plants.

A. Absinthium L. Common Wormwood. Absinth.

A shrubby, silky, hairy plant from 2-3 feet high; leaves 2-3 pinnately parted, the lobes lanceolate, obtuse; heads in racemose panicles, nodding yellow, marginal flowers pistillate, fertile or sterile, central flowers fertile; involucre hemispherical outer bracts linear.

Distribution. Native to the old world but escaped from gardens and found along roadsides. From Newfoundland to Massachusetts and North Carolina; occasionally westward to Wisconsin and Montana.

Poisonous properties. Wormwood is a stimulant and tonic and has been employed chiefly for digestive disorders, although seldom used medicinally. The volatile oil of wormwood in large doses produces cerebral disorders, convulsions and even death. The well-known absinthe is made from this plant and used with alcoholic drinks. For this purpose the plant is extensively cultivated in Europe and to some extent, in Nebraska, Michigan and Wisconsin. Absinthe contains the principle *absinthin* $C_{15}H_{20}O_4$. Dr. Rusby, in speaking of absinthe says that absinthium is in a general way similar in composition and properties as a poison to *Tanacetum vulgare* though the symptoms are more largely cerebral. Neither is it liable to be taken except for medicinal purposes or as an addition to spirits. As a result of the latter, poisoning is usually chronic and extremely difficult to cure. Dr. Millspaugh reports the experience of a clerk who took about a half ounce of the oil; he was found on the floor perfectly insensible, convulsed, and foaming at the mouth; shortly afterward the convulsions ceased, the patient remained insensible with the jaws locked, pupils dilated, pulse weak, and stomach retching. After causing free emesis and applying stimulants, the man recovered, but could not remember how or when he had taken the drug. According to Dr. Legrand, the effects prominent in absinthe drinkers are: Derangement of the digestive organs, intense thirst, restlessness, vertigo, tingling in the ears, and illusions of sight and hearing. These are followed by tremblings in the arms, hands, and legs, numbness of the extremities, loss of muscular power, delirium, loss of intellect, general paralysis, and death. Dr. Magnan, who had a great number of absinthe drinkers under his care, and who performed many experiments with the liquor upon animals, states that peculiar epileptic attacks result, which he has called "absinthe epilepsy."

Post-Mortem.—Great congestion of the cerbro-spinal vessels, of the meninges of the brain, extreme hyperaemia of the medulla oblongata, injection of the vessels of the cord, with suffusion of the cord itself. The stomach, endocardium, and pericardium show small ecchymoses.

Absinthe is sometimes added to hops to make beer more exhilirating.

A. vulgaris L. Common Mugwort

Tall, branching perennial with fine and closely appressed hairs; leaves mostly smooth and green above, but quite woolly underneath; pinnatifid, the divisions cut-toothed, linear-lanceolate; heads small in open leafy panicles.

Distribution. In waste places from Canada to North Carolina to Pennsylvania and occasionally westward.

Poisonous properties. The common mugwort was used medicinally by the physicians of the 16-18 century, but in modern times the plant is not used to any extent. Mugwort causes epileptic spasms, profuse sweat with the odor of garlic; violent contractions of the uterus; labor-like pains; prolapsus and rupture of the uterus; miscarriage; metrorrhagia and increase of lochial discharges.

24. *Arnica* L.

Perennial herbs, erect, simple or branching; leaves opposite, or rarely with the upper alternate; heads many-flowered, radiate on long peduncled heads; scales of the involucre bell-shaped; bracts in 1-2 series; the ray flowers pistillate and fertile; disk flowers perfect and fertile; achenes linear, 5-10 ribbed; pappus of roughened-denticulate bristles.

About 30 species native to the Northern Hemisphere. The tincture of arnica is a well-known house remedy used for bruises and chilblains. *A. montana* contains a bitter principle *arnicin* $C_{20}H_{38}O_4$. The value of arnica as a germicide has been largely overestimated. The germicidal action is probably due to the presence of alcohol. Dr. White, in his Dermatitis Venenata, records several instances of injurious effects from the use of arnica. In one case a gentleman descending the stairs to mount his horse for a ride, slipped and scraped the lower part of his back. A handkerchief dipped in the tincture was applied to the bruised skin and worn in contact with the part during the ride. During the ride he felt considerable itching and upon his return home found that the skin was greatly congested. On the next day I was called to see him. The skin of the back, nearly to the shoulders, was in a state of active hyperaemia, and already covered with innumerable papules. The inflammatory process extended rapidly downwards nearly to the knees, and forward upon the abdomen and genitals. In a few days these parts presented all the characteristic appearances of acute eczema in its various stages of progression: general hyperaemia, papules, vesicles, excoriated and exuding surfaces, and crusts. The subjective symptoms were intense itching, stinging, and burning in the parts. Scarcely any clothing could be borne in contact with the skin by day, and sleep was for a few nights almost impossible, but the system generally was only slightly disturbed. Dr. White records two other cases. All three seem to have been old gentlemen and he states: "In all of them we have an acute inflammatory process, confined to the upper dermal layers, and manifesting itself, according to the stage reached, by the following appearances: hyperaemia, papules, vesicles, excoriations, crusts, and scales, in regular sequence. The local sensations were intense itching and some degree of burning in the parts affected."

Arnica cordifolia Hook. Arnica

A low perennial, 1-2 ft. high or less; pubescent, or the stem hirsute and peduncles villous; the root and leaves deeply cordate or ovate at the base, on slender petioles; stem leaves opposite, in 1-3 pairs, dentate or denticulate; upper small, sessile; heads few, solitary; involucre pubescent or villous; rays an inch long; achenes more or less hirsute.

Distribution. Higher altitudes of the Rocky Mountains, from Colorado to California and British Columbia.

Arnica mollis Less. Hook.

A leafy branching perennial, tomentose or villous-pubescent or nearly smooth; leaves denticulate or dentate, acute or obtuse; lower leaves tapering into a margined petiole, upper broader at the base and clasping; flowers much smaller than the preceding; ray flowers yellow; achenes hirsute-pubescent.

Arnica monocephala Olin.

An erect, simple, branching perennial, from 1-2 feet high; leaves opposite; long peduncled heads; leaves narrow, oblong and lanceolate, the upper linear; ray flowers, yellow.

Distribution. Grows in woods and moist localities, Montana to New Mexico and westward.

Poisonous properties. This well-known arnica has, for some time, been suspected of being poisonous. When bruised all the plants exhale the odor of arnica. Chesnut and Wilcox state:

> It has an odor and taste much like that of the official drug, and, in fact, an extract made from the heads is considerably used locally as a liniment. No specific cases of poisoning caused by the plant have been reported from Montana, and we are not aware that it is eaten, but it has, nevertheless, been suspected of being poisonous to stock.
>
> Dr. S. B. Nelson states that a sheep ate 2 pounds (of the leaves?) of *A. alpina* within a day without experiencing any bad effect. The plants had been gathered eighteen hours.

25. *Senecio* (Tourn.) L. Groundsel

Perennial or annual herbs; shrubs or trees; leaves alternate; heads many flowered, solitary, corymbose or paniculate; involucre cylindrical or bell shaped; principal bracts in one series, distinct or united at the base, usually with some shorter rays, outer ones pistillate or none; disk flowers perfect; corolla tubular; achenes terete or those of the marginal flowers compressed; 5-10 ribbed; pappus of numerous capillary bristles. A large genus of 1000 species of wide distribution. Some ornamental. Some species have been looked upon as poisonous.

Dr. Day, in the Twenty-third Annual Report of the Bureau of Animal Industry, 1906, gives the following in regard to a disease supposed to be associated with a species of this genus:

> At the present stage of the work there appears reason for associating this malady with an affection of cattle known in Nova Scotia as Pictou disease, with Winton disease of horses of New Zealand, and with Molteno cattle disease of South Africa. The tissues examined present practically the same lesions as those described for the above-mentioned affections—namely, interlobular connective tissue hyperplasia, fatty infiltration of the liver cells, and hemorrhages into the spleen.
>
> Pictou disease, Winton disease, and Molteno cattle disease have been investigated time and again in an endeavor to find a causative agent. All inoculation experiments have failed, and it has only been found of late that feeding experiments with certain weeds have given seemingly reliable results.
>
> Pictou disease, occurring in Pictou and Antigonish counties, Nova Scotia, is now ascribed to the ingestion of a weed called ragwort. Winton disease is thought to be caused by a member of the ragwort family, *Senecio Jacobaea.* The Molteno disease of South Africa is probably induced, according to recent investigations, by still another ragwort, *Senecio Burchelli.* At least these weeds when fed to animals in their respective localities have produced diseases followed by a train of symptoms corresponding to those seen in the naturally induced disease. The post-mortem findings were also quite similar. It was also proved that these plants were most dangerous in the young state. Yet another variety known as *Senecio latifolius* was found to be deadly to stock.

In some parts of the states in the west Senecios are common but they are not commonly found when this forage is cut for hay. It is extremely doubtful whether the Senecio occurring in the western part of Iowa is responsible for this disease. The groundsel or mug-wort (*Senecio Balsamitae*) blooms in May

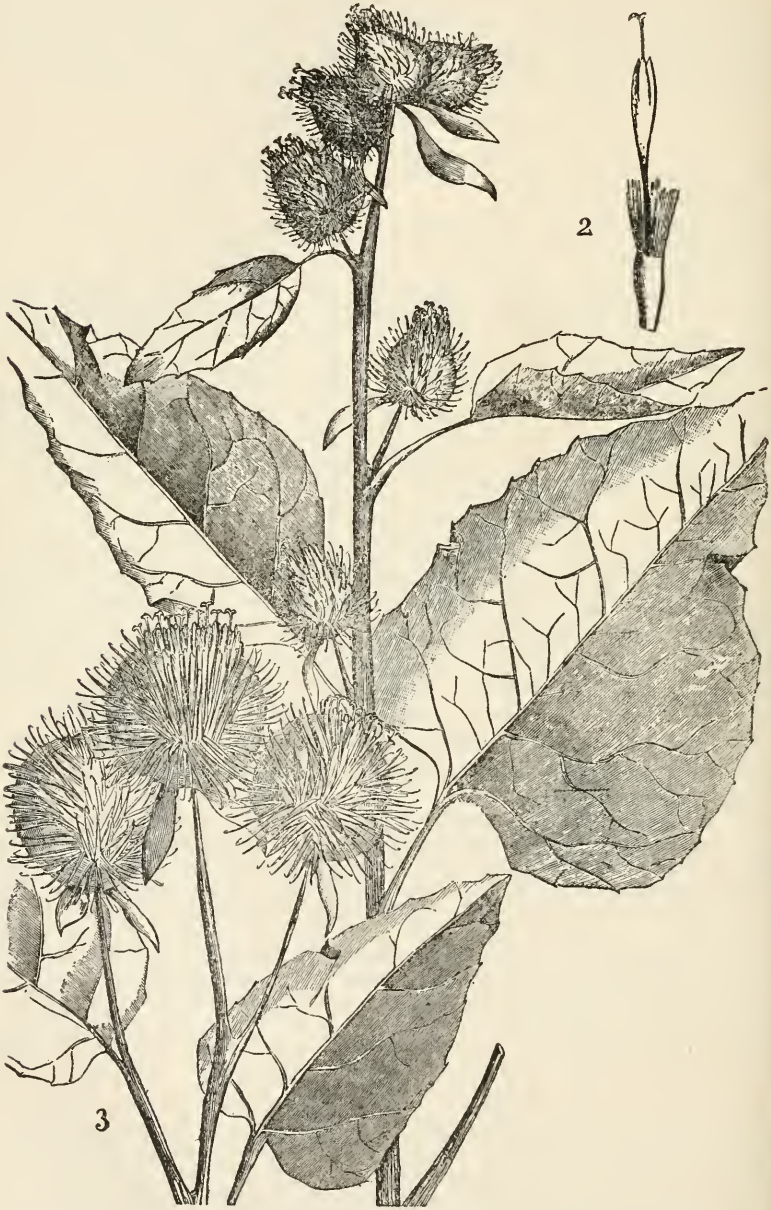

Fig. 454a. Burdock (*Arctium Lappa*). 1, general view of plant; 2, single flower; 3, scales of involucre hooked. These heads annoying to stock. (U. S. Dept. Agrl.)

and after blooming disappears except a few of the root leaves. The stinking Willie (*S. Jacobaea*) is naturalized in the east and of course may be responsible for the Pictou disease.

26. *Arctium* L. Burdock

Large coarse biennial, rough or pubescent herbs; leaves broad, alternate and petioled; heads large, recemose, corymbose or paniculate; flowers purple or white; all tubular perfect and similar; involucre globular; the scales imbricated; lanceolate, tipped with hooked points; receptacle flat, bristly; achenes oblong, somewhat compressed and 3-angled and wrinkled; pappus short, of numerous short bristles.

A small genus of 5 or 6 species in the old world. The root of the common burdock is used in medicine, while in Japan it is also used for food.

Arctium Lappa L. Burdock

A coarsely branched biennial from 1-3 feet high, hairy; leaves large, roundish or heart-shaped, thin obtuse, entire or dentate, floccose tomentose beneath; petioles deeply furrowed; heads of purplish or whitish flowers, clustered or somewhat corymbose; the involucre lengthened into hooked tips, glabrous or slightly cottony.

Distribution. Common from New Brunswick westward in the Canadian provinces in Canada, southward to Alabama, general in the Mississippi Valley, Rocky Mountain region, and Utah.

Poisonous and injurious properties. Where the burdocks are allowed to grow freely the burs cling to the fleece of animals, often forming large balls which may be found on the tails of cattle and horses. When they are common where sheep pasture, the burdocks work into the wool which soon becomes of little value. Formerly burdock was used medicinally more than it is at the present time. The root has diuretic properties. Dr. Johnson gives the chief medical properties as follows:

> Burdock, though chiefly used by the laity, is highly esteemed by some of the profession as a diuretic and alterative. It is, perhaps, more frequently used in rheumatism than in any other disease, but is also recommended in chronic cutaneous diseases, catarrhal affections, syphilis, and scrofula. In the form of an ointment or liniment it is used as an application to burns, ulcers, etc.
>
> Some forms of the burdock are used for food; the young stems when stripped of their rind may be eaten raw or boiled, or in a pottage with vinegar.

27. *Cirsium* (Tourn.) Hill. Thistle

Perennial, annual or biennial, erect, branched or simple, herbs; leaves sessile, alternate, often pinnatifid, prickly; heads usually large, many flowered, solitary or clustered; heads discoid, flowers purple, yellow or white, tubular, perfect and fertile or dioecious; involucre ovoid or globose, scales imbricated in many rows, often glutinous, tipped with a prickle or unarmed; receptacle flat or convex, bristly; corolla tube slender, the limb deeply cleft; anthers sagittate at the base; style elongated, branches short or obtuse, unappendaged, often with a pubescent ring below; achenes obovate or oblong compressed or obtusely four-angled, glabrous, often ribbed; pappus plumose or minutely serrulate.

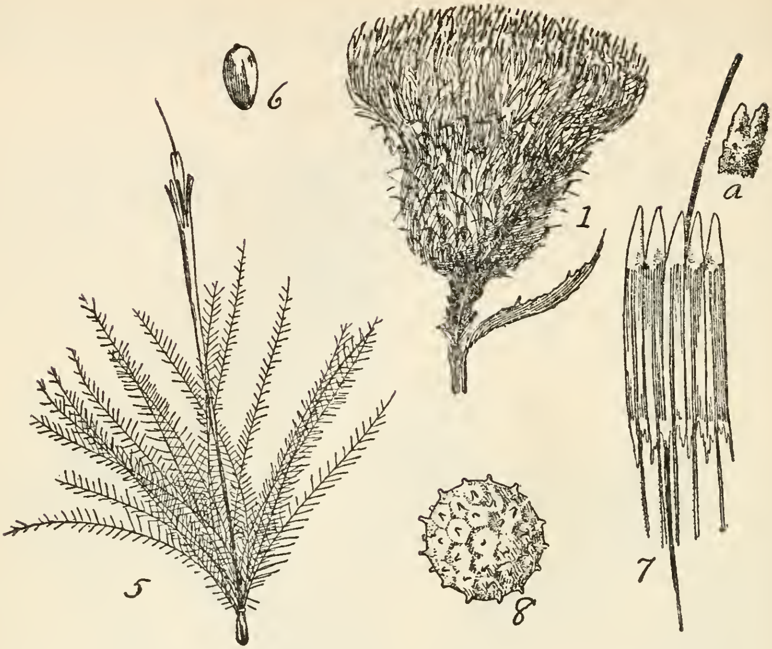

Fig. 455. Woolly Thistle (*Cirsium canescens*). 1, Head; 5, Flower and pappus; 6, Achene; 7, Anthers and style cut open; 8, Pollen grain; a, end of style. (Charlotte M. King).

About 200 species of the north temperate regions. Some of them are cultivated for ornamental purposes; many of the species are pleasantly scented; many of them are troublesome weeds. *Cnicin* $C_{20}H_{37}O_{10}$ has been found in a related genus (*Cnicus benedictus*). Horses are fond of the heads of many species like *C. eriocephalum, C. Drummondii, C. undulatus* and others that occur on the Rocky Mountains. None of the species are probably poisonous but many of them have irritating properties. The Canada thistle is used in domestic practice.

Cirsium arvense (L.) Hoffm. Scop. Canada Thistle

Smooth perennial herbs, spreading by creeping rootstocks, 1-3 feet high, corymbosely branched at the top; stem smooth; leaves lanceolate, sessile and deeply pinnatifid, lobes and margins of leaf with spiny teeth; heads small, ¾-1 in. high; bracts appressed, the outer with a broad base, inner narrow, all with an acute tip, never spiny; flowers purple, dioecious; in staminate plant, flowers exserted with abortive pistil; in pistillate, less so, scarcely exceeding the bracts; long stamens with abortive anthers, tube of the corolla 6 lines long, anther tips acute, filaments minutely pubescent, all of the bristles of the pappus plumose.

Distribution. The Canada thistle is found in waste places from Newfoundland, Nova Scotia, various provinces of Ontario, to New York, Virginia, southwest to Missouri and Kansas, Colorado to Idaho, Montana and Oregon.

Cirsium lanceolatum (L.) Hill. Bull Thistle

Branching biennial, 3-4 feet high, tomentose, becoming dark green and villous or hirsute with age, branchlets bearing large heads; leaves lanceolate,

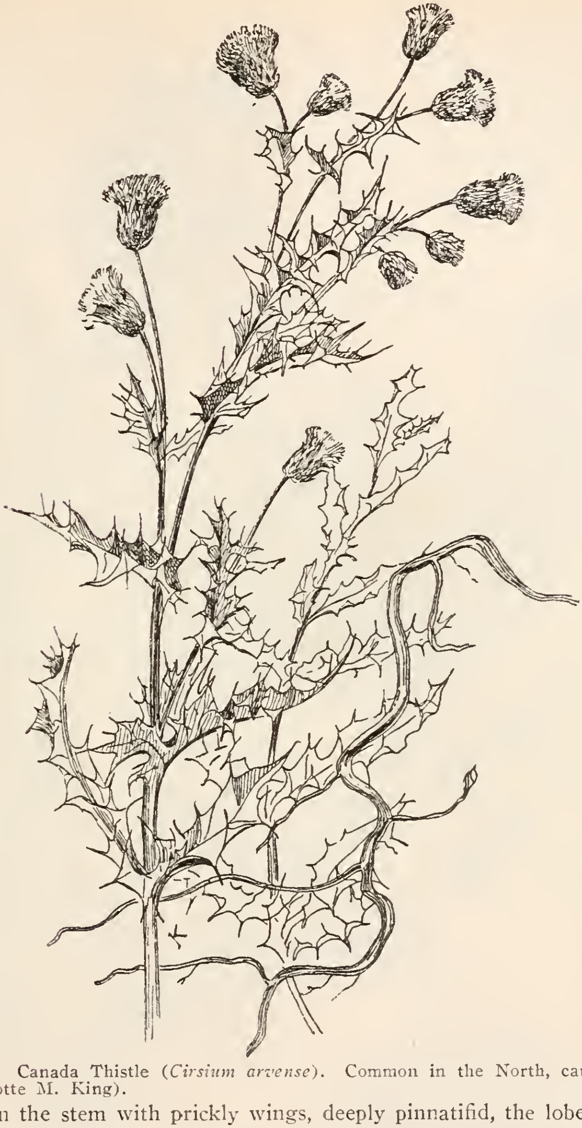

Fig. 456. Canada Thistle (*Cirsium arvense*). Common in the North, causes inflammation. (Charlotte M. King).

decurrent on the stem with prickly wings, deeply pinnatifid, the lobes with rigid prickly points, upper face roughened with short hairs, lower face with cottony tomentum; heads 1¾ to 2 inches high, bracts of the involucre lanceolate, rigid when young, more flexible with age, long attenuated prickly pointed spreading tips, arachnoid woolly; flowers perfect; anther tips acute; filaments pubescent; achenes smooth; pappus of numerous plumose bristles.

Distribution. Distribution in North America in fields and waste places from Newfoundland to Georgia, Missouri, Kansas to Nebraska, the Dakotas, Montana, Washington, Oregon and Idaho. Naturalized from Europe, native also to Asia.

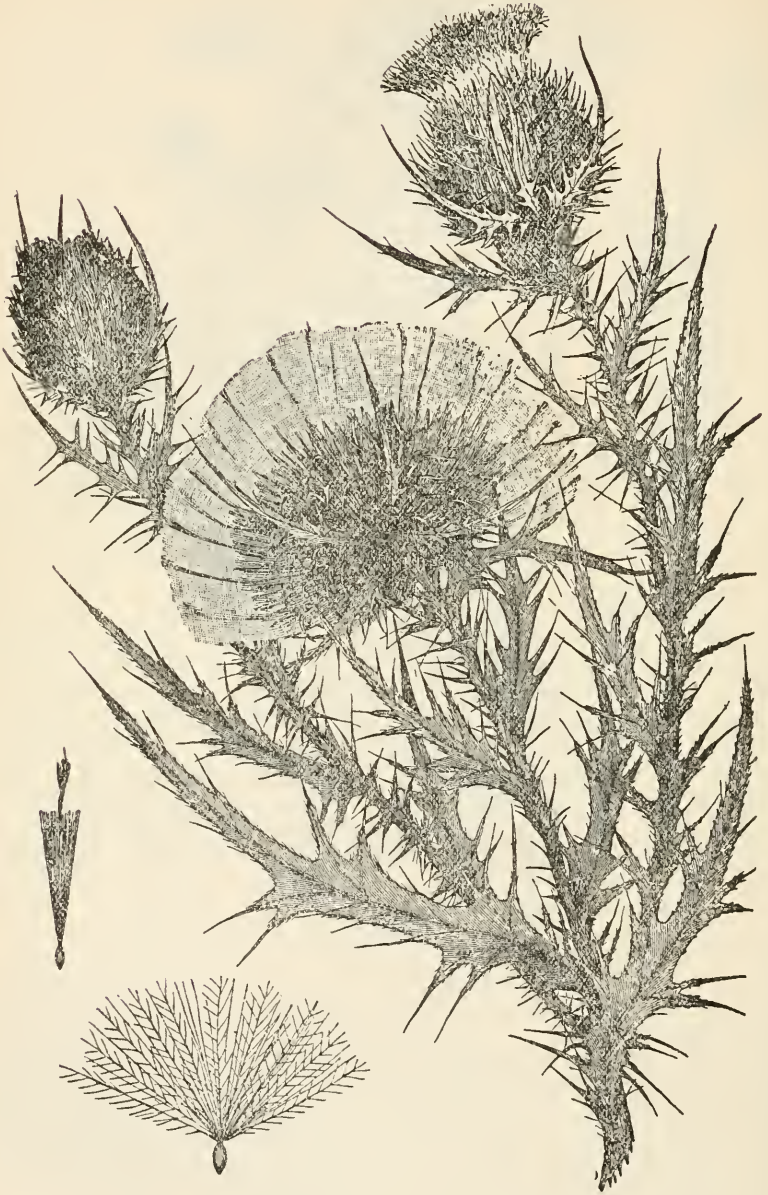

Fig. 457. Bull thistle (*Cirsium lanceolatum*). A common pasture weed. Causes mechanical injuries. (U. S. Dept. Agrl.)

Cirsium canescens Nutt. Woolly Thistle

Branching perennial 2-4 feet high, woolly throughout bearing single medium sized heads, stem angled, white woolly; leaves, radical 8 inches to 1 foot long, the divisions usually 2-lobed, prominently ribbed, ending in stout spines; stem leaves except the lower, 1-4 inches long, pinnatifid, the upper sessile, slightly roughened, with a slight cottony down, the lower white, woolly; heads 1½ to 2 inches high, bracts of the involucre somewhat arachnoid, lower scales with a broad base, glutinous ridge, and ending in minutely serrated spine, inner scales long, attenuated, tips straw colored; flowers purple. This is *Carduus Flodmannii* Rydb.

Distribution. This species is distributed from Mason City, Iowa, to southwestern Minnesota, west to the Rocky Mountains. Collected by Charles A. Geyer in 1839, and described by Nuttall. The writer has seen it very abundant in Wyoming, Montana and Colorado.

Cirsium discolor (Muhl.) Spreng. Prairie Thistle

Tall, branching, leafy biennial, 5-7 feet high, with heads larger than the Canada thistle; stem striate, slightly hirsute; leaves radical 12-14 inches long, deeply pinnatifid, the divisions frequently divided, prickly toothed, the upper surface smoothish, and the lower white, woolly single heads terminating the branches, with purple flowers, heads 1½ inches high; bracts of the globose involucre slightly arachnoid, lower bracts ovate, with a broad base and a weak prickly recurved bristle, slight dorsal gland, inner linear lanceolate with a nearly colorless entire appendage; flower purple; lobes of the corolla terminating in clavate tips, anther tips acute, filaments pubescent; bristle of pappus plumose; achenium smooth, upper part yellow.

Distribution. In fields and along roadsides from Quebec, Ontario, south through New England, New York and Georgia, west to Missouri, Nebraska and South Dakota.

Cirsium ochrocentrum Gray

Biennial, 2-8 feet high; white tomentum; leaves commonly deeply pinnatifid and armed with long yellowish prickles; heads 1-2 inches high; involucral scales with a viscid line on the back, with a prominent spreading yellowish prickle; corolla purple, rarely white.

Distribution. From Arizona to Colorado and Utah.

Cirsium undulatum (Nutt.) Spreng.

Biennial 1-2 feet high, white tomentose; leaves pinnately parted, somewhat prickly; heads about 2 inches high; the outer bracts thickened by glandular-viscid ridge; corolla rose-color, purple or pale purple; the variety *megacephaleum* with larger heads.

Distribution. West of the Missouri River to Oregon and New Mexico.

Injurious properties. None of the species is poisonous so far as the writer knows. The spiny involucre and spiny leaves inflict inflammation and cause the formation of pus.

28. *Centaurea* L.

Perennial or annual herbs, with leaves alternate, entire, dentate, incised or pinnatifid; involucre ovoid or globose; bracts in many series; marginal flowers usually neutral and larger than the central ones in some species; all the flowers perfect and fertile; heads middle-sized, tubular, purple-violet, or white or rarely yellow; receptacle flat and bristly; corolla-tube slender and 5-cleft or 5-lobed; anthers sagittate at the base; achenes oblong or obovoid; pappus of several series of bristles and scales.

About 350 species mostly of the old world where they are troublesome weeds. The common bluebottle or corn flower is frequently cultivated in gardens and is a frequent escape from cultivation.

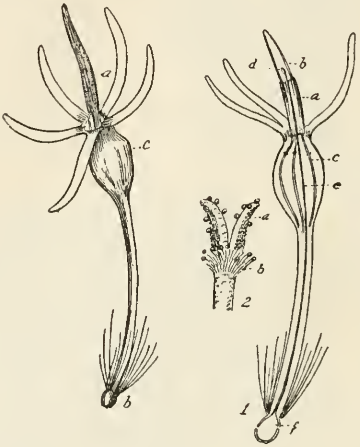

Fig. 458. Flowers of centaurea. 1, Flower; a, anther; 2, style. At the left, Achene and Pappus.

Centaurea solstitialis Linn. Knapweed

Erect, branched, cottony, stems winged, lower leaves lyrate, upper linear entire, decurrent, spines of upper bracts long spreading with a few smaller ones at the base, pappus soft.

Distribution. Fields in California, also in Europe and England, rare; introduced with alfalfa. Introduced into Iowa with alfalfa seed.

Injurious properties. Because of the spiny character of the plant it is often troublesome to man and animals.

29. *Silybum* (Vaill.) Adans. Milk Thistle

Annual or biennial, much branched herbs; leaves large, alternate, clasping, white-blotched; heads discoid, solitary at the end of the branches; involucre large; bracts rigid, some armed with large spreading or recurved spines; flowers all tubular; corolla-tube slender, top 5-cleft; anthers sagittate; achenes obovate-oblong; pappus-bristles in several rows.

A single species, native to the Mediterranean region.

Silybum Marianum (L.) Gaertn. Lady's Thistle

A tall branched glabrous annual with striate stem; leaves oblong lanceolate, prickly clasping.

Distribution. Occasionally found eastward especially in ballast and common on the Pacific coast, from British Columbia to Southern California.

Injurious properties. The spiny leaves and involucre have been troublesome; produces mechanical injuries.

A CATALOGUE OF THE POISONOUS PLANTS OF THE WORLD

In the following catalogue an attempt has been made to record all of the species that have been in some way or another regarded as poisonous or injurious to man. This catalogue, however, is based mainly on the plants listed by Greshoff, Cornevin, Chesnut, Ernst, Lyons, Maiden, Miquel, Radlkofer, Rusby, Smith, White in "Dermatitis venenata," but includes also a few from other scattered sources. The poisonous fungi were listed from Atkinson, Hard, Clements, and some from Fries, Peck, Farlow, and Bulliard. It was not thought best to list the fungi from the works of Ratzeburg and Phoebus entirely because of the uncertainty as to the poisonous qualities. It should be stated that many of the plants in this list are not poisonous nor are they always given as poisonous by the authors credited to them after the species, in fact, many of them on the whole must be regarded as plants simply having medicinal virtues. It was thought best, however, to list them, to permit future investigators to take up the problem of the chemistry and poisonous qualities of these plants from an experimental standpoint. It is simply an indication of the lines along which work should be done. We have also indicated the action of the plant, or in some few cases the important substance found in the plant. The alphabetical arrangement has been adopted except as to the lower forms. In the last column the distribution is indicated usually only where the plant is indigenous, but in some cases North America is added where the plant has been introduced.

I have been greatly aided in this work by the excellent treatise of A. B. Lyons, "Plant Names, Scientific and Popular," published by Nelson Baker & Co., and also by the excellent work of Sayre, "Organic Materia Medica and Pharmacognosy."

In the preparation of this catalogue I have received very substantial help from Miss Harriette S. Kellogg, who has looked after the details in catalogueing the species and the synonyms. In some cases the synonyms could not be found in the Kew Index, and these have been allowed to stand as they were given by the authors. Some duplication of names may occur, and possibly through an oversight some have been placed in the wrong orders, but I ask the reader's indulgence in errors of this kind.

Finally, I am indebted to Miss Bertha D. Herr for the laborious task of getting the copy ready for the printer. L. H. Pammel.

The following abbreviations refer to the properties mentioned in the third column of the catalogue.

Abort.—abortifacient
Acr.—acrid poison
Alk.—alkaloidal poison
Amyg.—contains amygdalin
Androm.—contains andromedotoxin
Anes.—anesthetic
Ant.—anthelmintic
Antisc.—antiscorbutic
Antisp.—antispasmodic
Astr.—astringent
Berb.—contains berberin
Card.—cardiac poison
Cath.—cathartic
Con.—convulsive
Cou.—contains coumarin
Cur.—curare poison
Cyt.—contains cytisin
Del.—deleriant

A. P.—arrow poison
Ast.—asthenic
Dr. Em.—drastic-emetic
Em.—emetic
Ent.—causes enteritis
Eser.—contains eserin
Exp.—expectorant
F. P.—fish poison
Gastr.—causes gastro-enteritis
Hyd.—contains HCN.
Hyp.—hypnotic
Ineb.—inebriant
Ins.—insecticide
Intox.—intoxicant
Ir.—irritant
Lax.—laxative
Loco.—causes loco poisoning
Mech.—causes mechanical injuries
Nar.—narcotic
Diaph.—diaphoretic
Diur.—diuretic
Naus.—nauseant
Ord.—ordeal poison
Par.—paralyzing
Pur.—purgative
Sap.—contains saponin
Sed.—sedative
Sial.—sialagogue
Sol.—contains solanin
Sop.—soporific
Stim.—stimulant
Taen.—taenifuge
Toxal.—Contains a toxalbumin.
Tymp.—causes tympanites
Ur.—causes uraemic poisoning
Urt.—urticarial
Ver.—vermifuge
Ves.—vesicant

The abbreviations for the literature referred to are as follows:

C.—Cornevin's Les plantes vénéneuses et ses empoisonnements qui elles determinent.

Ches.—Chesnut's Preliminary Catalogue of Plants Poisonous to Stock.

E.—Ernst's Ueber fischvergiftenden Pflanzen.

G.—Greshoff's The Distribution of Prussic Acid in the Vegetable Kingdom. Phytochemical Investigations at Kew.

K.—Kirtikar's The Poisonous Plants of Bombay.

L.—Lyon's Plant Names, Scientific and Popular.

M.—Maiden's Plants reputed to be Poisonous to Stock in Australia.

M.i—Miquel's Poisonous Plants of North Netherlands.

R.—Radlkofer's Plants said to be Poisonous to Fish.

Rusby—Rusby's The Poisonous Plants of the Vicinity of New York City.

Sm.—Smith's Poisonous Plants of all Countries.

Wh.—White's Dermatitis venenata.

ACANTHACEAE

NAME OF PLANT	Authority	Properties	Locality
Hygrophila hispida Nees.	G.	Em.	Cuba
Justicia Gendarussa Burm.	G.		Tr. As.
Lepidagathis Wightiana Benth.	G.	Abort.	
Paulowilhelmia polysperma Benth.	G.	F. P.	Tr. Afr.
Paulowilhelmia speciosa Hochst.	G.	Em.	Abyss.
Rhinacanthus communis Nees.	G.		Ind. Malay. Burma Abyss.
Ruellia patula Nees.	G.	Em.	Arab. Ind.
Ruellia strepens L.	G.	Em.	N. Am. W. Ind.
Ruellia tuberosa L.	G. L.	Em.	N. Am. Tr. Am.

ADOXACEAE

ALISMACEAE

Alisma Plantago L.	G. M. L.	Ir.	Tem. N. Am. Austr.

AMARANTHACEAE

NAME OF PLANT	Authority	Properties	Locality
Achyranthes bidentata Bl.	G.	Sap.	Tr. As.
Amaranthus gangeticus L.	G.	Sap.	Trop. Reg.
Amaranthus hybridus L.	L.	Astr.	Eur. N. A.
Amaranthus hypochondriacus L.	G.	Sap.	N. Am. Eur.
Amaranthus viridis L.	G.	Sap. Ant.	Tr Reg
Celosia anthelmintica Aschers.	G.	Ant.	Tr. Afr.
Celosia trigyna L.	G.	Taen.	Tr. Afr.
Deeringia celosioides R. Br.	G.		As. Tr. Austr.

AMARYLLIDACEAE

Amaryllis Belladonna L.	G.		S. Afr.
Buphane disticha Herb.	G.C. Sm.L.	A. P.	S. Afr.
Crinum asiaticum L.	G.		Tr. As.
Crinum zeylanicum L.	G.		Ind.
Curculigo scorzoneraefolia Baker	G.		Tr. Am.
Furcraea gigantea Vent.	G.	Sap.	Tr. Am.
Galanthus nivalis L.	G.		Eur.
Haemanthus	G.		Afr.
Haemanthus coccineus L.	L.	Diur.	S. Afr.
Hippeastrum equestre Herb.	G.		Mex.
Hippeastrum rutilum Herb.	G.		Brazil
Hymenocallis sp.	G.		Tr. Am.
Leucojum aestivum L.	C.		Ori.
Leucojum vernum L.	G.		Eur.
Lycoris radiata Herb.	G.	Em.	China.
Narcissus poeticus L.	Mi.	Ir.	Eur.
Narcissus Pseudo-Narcissus L.	M.G.C.L.	Ir.	Eur.
Narcissus Tazetta L.	Mi.		Med. Reg.
Pancratium Illyricum L.	G.		Eur. Austr.
Pancratium maritimum L.	G. C. L.	Diur.	Med. Reg. N. Am.
Pancratium zeylanicum L.	G.		Ind.
Sprekelia formosissima Herb.	G.		Mex.
Zephyranthes Atamasco Herb.	Ches.		N. A.

ANACARDIACEAE

Buchanania sp.	G.		Tr. As. Pac. Is. Austr.
Comocladia glabra Spreng.	G.		Cuba.
Corynocarpus laevigata Forst.	G.	Con.	N. Zeal.
Gluta Benghas L.	G.		Java.
Holigarna caustica Roxb.	G.		Ind.
Holigarna longifolia Roxb.	G.		Ind.
Lithraea venenosa Miers.	G.		S. Am.
Mangifera indica L.	G.		Malay, Ind.
Oncocarpus vitiensis A.	G.		Fiji Is.
Pistacia Khinjuk Stocks	G.	Ir.	Egyp. Pers. Him.
Pseudosmodingium perniciosum Engl.	G.	Ir.	Mex.
Rhus Cotinus L.	C.		Eur. China. Med. Reg.
*Rhus glabra L.	L.	Astr.	N. A.

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* Just as this part of the work is going to press I have received two important papers on Rhus by L. E. Warren in which the statement is made that the poisonous substance of Rhus is a powerful escharotic, one milligram producing very severe blistering when

NAME OF PLANT	Authority	Properties	Locality
Rhus Metopium L.	L.	Emeto-Cath	N. A. W. I.
Rhus Toxicodendron L.	G. L.	Ir.	N. Am.
Rhus venenata DC.	G.	Ir.	N. Am.
Rhus vernicifera DC.	G. L.	Ir.	Thib. Jap.
Sclerocarya Caffra Sond.	G.	Ir.	S. Afr. Austr.
Semecarpus Anacardium L.	G. L.	Ir.	As. Tr. Austr.
Semecarpus heterophylla Bl.	G.	Ir.	Java.
Spondias mangifera Willd.	G.	Ir.	Trop. As.
ANONACEAE			
Anona amara Raeusch.	G.		Guiana
Anona Cherimolia Mill.	G.	F. P.	Tr. Am.
Anona muricata L.	G. L.	Astr.	Tr. Am.
Anona palustris L.	G. L.	F. P.	Tr. Am. & Af
Anona reticulata L.	G. L.	Acr.	Tr. Am.
Anona spinescens Mart.	G.		Brazil.
Anona squamosa L.	G. L.	F. P.	Ind.
Asimina triloba Dun.	G. L.	Em.	N. Am.
Goniothalamus macrophyllus Hook.	G.		Malacca.
Guatteria veneficiorum Mart.	G.		Brazil.
Popowia pisocarpa Endl.	G.		Java.
Xylopia odoratissima Welw.	G.		Tr. Afr.
Xylopia polycarpa Oliv.	L.	Berb.	Tr. Afr.
Xylopia salicifolia HBK.			Tr. S. Am.
APOCYNACEAE			
Acokanthera Lamarkii G. Don.	G.		S. Afr.
Acokanthera venenata G. Don.	G.		S. Afr.
Adenium Boehmianum Schinz.	G.		Afr.
Adenium obesum Roem & Schult.	G.		Afr. Arab.
Adenium somalense Oliv.	G.	A. P.	Afr.
Aganosma calycina A.DC.	G.	F. P.	Ind.
Allamanda cathartica L.	G.	Em.	Tr. Am.
Alstonia constricta F. Muell.	L.	Bitter	
Alstonia Scholaris R. Br.	G. L.		Trop. Old World
Alstonia venenata R. Br.	G.		Ind.
Alyxia buxifolia R. Br.	G.		Austr.

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placed on the arm for fifteen minutes. When in contact with the air it produces the characteristic non toxic varnish. The resinous products from the latex of the Rhus give black compounds with the alkali hydroxides. The irritating properties he thinks will be found to be connected with the presence or the relations of these hydroxyl groups.

This writer found that the milk sap of *Rhus vernix* is analagous in almost every particular to the Japanese lac. Warren agrees with nearly everyone else that the bacterial infection theory has very little to support it. Nor is there much to support the recently elaborated theory of immunity. He shows how a popular impression in regard to supposed immunity has become widespread even among scientists. It has not, however, been demonstrated. In the same way, contrary to the early published records, *Rhus Michauxii* has been shown by Warren and Trelease not to be poisonous. As to treatments, Warren, after an extensive investigation of the subject, states that the great majority are empirical. "There is no specific for this troublesome complaint. Remedies which have alleviated the symptoms in one case have proved utterly valueless or worse in others." The following species are listed by Warren as poisonous:

Rhus venenata D. C. (R. vernix L.); *Rhus radicans* L.; *Rhus Toxicodendron* L.; *Rhus diversiloba* Torr. & Gray; *Rhus Rydbergii* Small; *Rhus Metopium* L.; *Rhus floridana* Mearns; *Rhus littoralis* Mearns; *Rhus vernicifera* DC; *Rhus succedanea* L.; *Rhus sylvestris* Sieb. & Zucc.; *Rhus Wallichii* Hook. fils; *Rhus Griffithii* Hook. fils; *Rhus striata* R. & Pav.; *Rhus perniciosa* H. B. & K.; *Rhus chinensis* Mill.; *Rhus javanica* L.; *Rhus caustica* Hook. & Arn.; *Rhus lucida* L.

NAME OF PLANT	Authority	Properties	Locality
Alyxia daphnoides A. Cunn.	G.		Norfolk Is.
Amsonia Tabernaemontana Walt.			N. Am.
Apocynum androsaemifolium L.	Ches. G.C. Rusby L.	Card.	N. Am.
Apocynum cannabinum L.	Ches. G.C. Rusby L.	F. P. Card.	N. Am.
Apocynum venetum L.	G.		Med. Reg. Orient N. As. Ind.
Aspidosperma quebracho-blanco Schlecht.	G. L.		S. Am.
Aspidosperma sessilifolium Fries.	G. R.	F. P.	S. Am.
Cameraria latifolia L.	G.		Ind.
Carissa ovata R. Br	G.		Austr.
Carissa Xylopicron Thou.	G.		Mascar Is.
Cerbera Odollam Gaertn.	G. C. R.	F. P.	Ind. Malay.
Cerbera Tanghin Hook.	C. L.		
Echites alexicaca Mart. & Stadelm.	L.	Cath.	Braz.
Echites maculata A. DC.	G. C.		St. Doming. Is.
Echites venenosa Mart.	G. L.	A. P.	Brazil.
Ellertonia Rheedi Wight.	G.		Ind.
Geissospermum vellosii Allem	G. L.	Bitter	Braz.
Haplophyton cimicidum A. DC.	G.	Ins.	Mex.
Malouetia nitida Spruce	G. L.	A. P.	Braz.
Melodinus monogynus Roxb.	G. R.	F. P.	Him. Malaya. China.
Nerium odorum Soland.	G.	Car.	Per Jap. Ind.
Nerium Oleander L.	G. C. Mi. Ches. L.	Car.	Med. Reg. Ori.
Ochrosia Moorei F. von Muell.	G.		Austr.
Plumiera rubra L.	C. L.		Trop. Am.
Pottsia cantonensis Hook & Arn.	G.		Ind. Java China
Prestonia toxifera	G.		
Rauwolfia serpentina Benth.	G.	F. P.	Ind. Java.
Rauwolfia trifoliata Gaertn.	G.		Java.
Rauwolfia verticillata Baill.	G.	F. P.	
Strobilanthes callosus Nees.	K.		Ind.
Strophanthus Eminii Asch.	L.	A. P.	Cent. Afr.
Strophanthus hispidus DC.	G. L.	F. P. A. P.	S. Afr.
Strophanthus Kombe Oliver	L.	F. P.	Trop. Afr.
Strophanthus Pierrei Heim.	G.		W. Afr.
Tabernaemontana Borbonica Lam.	G.		
Tabernaemontana citrifolia L.	G.		Ind. Mex.
Taberaemontana coronaria Willd.	G.		Ind.
Taberaemontana malaccensis Hook.	G.		Malacca.
Taberaemontana Mauritiana Poir.	G.	F. P.	Mascar. Is.
Tabernanthe Iboga Baill.	G.		Trop. Afr.
Thevetia Ahouai A.DC.	G. R.	F. P.	Brazil.
Thevetia nereifolia Juss.	G. C. R. L.	F. P.	Tr. Am.
Urechites suberecta Muell.	G. L.	Sed.	St. Doming. Is.
Vinca major L.	G. L.	Abort.	Med. Reg.
Vinca minor L.	L.	Astr.	Eur.
Vinca pusilla Murr.	G.		Ind.

AQUIFOLIACEAE

Ilex Cassine Walt.	Sm. L.	Em. Cath.	N. Am.
Ilex glabra A. Gray	L.	Astr.	N. A.
Ilex verticillata A. Gray	L.	Astr.	N. A.

ARACEAE

NAME OF PLANT	Authority	Properties	Locality
Alocasia indica Schott.	G.		Ind. Malay.
Alocasia montana Schott.	G.		Ind. Malay.
Amorphophallus viridis Bl.	G.		
Anthurium Ferrierense		Ir.	
Arisaema curvatum Kunth.	G.	Ir.	Him. Reg.
Arisaema tortuosum Schott.	G.	Ir.	Him. Reg.
Arisaema triphyllum Schott.	Rusby	Em.	N. A.
Arisaema vulgare Targ.	G.	Ir.	Med. Reg.
Arum Dioscoridis Sibth.	G.		Greece As. Min
Arum Dracontium Schott.	L.	Acr.	N. A.
Arum italicum Mill.	G. C. Mi.	Sap.	Eur.
Arum maculatum L.	G. Mi.	Ir.	Eur.
Arum triphyllum Schott.	L.	Acr.	N. A.
Caladium bicolor Vent.	G.	Ins.	Am. Austr.
Calla palustris L.	G. C. L.	Acr.	Eur. As. N.Am.
Colocasia antiquorum Schott.	G. L.	Acr.	Tr. As.
Colocasia gigantea Hook f.	G.	Acr.	
Colocasia virosa Kunth	G.	Acr.	Ind.
Cryptocoryne spiralis Fisch.	G.	Em.	Ind.
Cyrtosperma Merkusii Schott.	G.		Sumatra.
Dracontium asperum C. Koch.	G.		Brazil.
Dracunculus vulgaris Schott.	C.		S. Eur.
Epipremnum mirabile Schott.	G. L.	Ant.	Java.
Homalomena aromatica Schott.	G.		Malay. Ind.
Lasia aculeata sp. Lour.	G.	Hyd.	Tr. As.
Monstera pertusa Schott.	G.	Ir.	Tr. Am.
Philodendron bipinnatifidum Schott.	G.		Brazil.
Philodendron hederaceum Schott.	G.	P.	S. Am.
Philodendron Imbe Schott.	G.	Em	Argentine.
Philodendron Simsii Sweet.	Sm.	Ir.	Guiana.
Pinellia tuberifera Ten.	G. L.	Ir.	Japan.
Scindapsus officinalis Schott.	G.	Ant.	Burma.
Spathiphyllum candicans Poepp.	G.		Trop. Am.
Symplocarpus foetidus Nutt.	Sm.	Ir.	E. N. Am.

ARALIACEAE

Aralia sp.	G.	Sap.	N. Am. Asia
Aralia hispida Vent.	L.	Dur.	N. E. U. S.
Aralia nudicaulis L.	L.	Dur.	N. E. U. S.
Aralia racemosa L.	G. L.	Em.	N. A.
Aralia spinosa L.	L.	Diur.	N. Am.
Hedera Helix L.	G. C. L.	Em. Nar	Eur. Afr. As.
Heptapleurum emarginatum Seem.	G.		Zeylan.
Heptapleurum scandens Seem.	G.		Malay.
Heptapleurum venulosum Seem.	G.		Austr.
Panax sp.	G.	Sap.	N. Am. As.
Polyscias sp.	G.	Sap.	Austr. N. Zeal. Afr. Madagas. Malay. Pac. Is.
Polyscias nodosa Seem.	G.	F. P.	Malay.
Trevesia sp.	G.	Sap.	Java. Sumatra.

ARISTOLOCHIACEAE

Aristolochia anguicida Jacq.	G.	Diaph.	S. Am.
Aristolochia antihysterica Mart	G.	Em.	Brazil.
Aristolochia argentina Griseb.	G.	Em.	Argent. Reg.

NAME OF PLANT	Authority	Properties	Locality
Aristolochia brasiliensis Mart. & Zucc.	G.	Em.	Brazil.
Aristolochia Clematitis L.	G. C. Mi.	Em.	Eur. Caucas. Reg. As. Minor.
Aristolochia elegans Mast.	G.	Em.	Brazil.
Aristolochia grandiflora Arruda	G. C.		Pernamb.
Aristolochia indica L.	G.		Ind.
Aristolochia Kaempferi Willd.	G.		Japan.
Aristolochia longa L.	C. L.		Med. Reg.
Aristolochia pallida Willd.	G.	F. P. Nar.	Eur. As. Minor.
Aristolochia Pistolochia L.	C. L.		Med. Reg.
Aristolochia rotunda L.	G. L.	Nar.	Med. Reg.
Aristolochia Serpentaria L.	L.	Diaph.	E. U. S.
Aristolochia sp.	E.	F. P.	Italy.
Asarum albivenium Regel.	G.	Em.	Japan.
Asarum arifolium Mx.	L.	Ir.	N. A.
Asarum canadense L.	G. L.	Ir.	N. Am.
Asarum caudatum L.	L.	Ir.	Calif.
Asarum europaeum L.	Mi. Sm. L.	Ir. Em.-Cat.	Eur.
Asarum virginicum L.	L.	Ir.	N. A.
Bragantia tomentosa Bl.	G.	F. P.	Ind. Malay.
Thottea dependens Klotzsch.	G.	Ir.	Malay.

ASCLEPIADACEAE

Araujia sericifera Brot.	G.	Em.	Peru.
Asclepias curassavica L.	G. L.	Em.	S. Am.
Asclepias eriocarpa Benth.	L.	Em.	W. N. Am.
Asclepias incarnata L.	Ches. C. L.	Ant.	N. Am.
Asclepias mexicana Cav.	Ches.	Em.	W. N. Am.
Asclepias syriaca L.	Ches. C. L.	Em.	N. Am
Asclepias tuberosa L.	C. Ches.	Em.	N. Am.
Calotropis gigantea R. Br.	G. L.	Em.	Ind.
Calotropis procera R. Br.	G.	Ineb	Peru N. Afr. Ind.
Ceropegia bulbosa Roxb.	G.		Ind.
Chlorocodon Whiteii Hook.	G.	Cou.	S. Afr.
Choristigma Stieckertianum.	G.		Arg.
Cosmostigma racemosa Wight.	G.		Ind.
Cryptostegia grandiflora R. Br.	G.		Tr. Afr. Ind. (Cult.).
Cynanchum acutum L.	G. C. L.	Cath.	Eur. Ori. As.
Cynanchum sarcostemmoides K. Schum.	G.		
Gonolobus laevis Mx.	G.	A. P.	N. Am.
Gonolobus obliquus R. Br.	G.		N. Am.
Gymnema latifolium Wall.	G.		Ind. Burma.
Gymnema sylvestre R. Br.	G. L.	Destroys sense of taste	Ind. Tr. Afr. Austr.
Hemidesmus indicus R. Br.	G. L.	Cou.	Zeylan.
Marsdenia Cundurango Nich.	L.	Dog Poison	S. A.
Marsdenia erecta R. Br.	G. L.		Syr.
Menabea venenata Baill.	G. L.	Ord.	Madagas.
Metaplexis Stauntoni Schult.	G.		China.
Morrenia brachystephana Griseb.	G.		Argentine.
Periploca graeca L.	G. L.	Em. Wolf-Poi.	S. Eur.
Periploca vomitoria Leschen.	G.	Em.	Java.
Sarcolobus carinatus Wall.	G.		Ind. Burma.
Sarcolobus narcoticus Miq.	G.	Nar.	Java.

NAME OF PLANT	Authority	Properties	Locality
Sarcostemma australe R. Br.	G. M.		Aust.
Sarcostemma glaucum HBK.	G.	Em.	S. Am. Venez.
Solenostemma Argel Del.	L.		Nubia.
Stapelia sp.	C.		S. Afr.
Tylophora asthmatica W. & A.	G. L.	Em.	Ind. Malay.
Tylophora fasciculata Ham.	G.	Em.	Ind.
Tylophora laevigata Decne.	G.	Em.	Maurit Is.
Vincetoxicum nigrum Moench.	C.	Dr. Em.	Eur. As. Minor.
Vincetoxicum officinale Moench.	C. Mi. L.	Dr. Em.	Eur. Cau. C.

BALSAMINACEAE

Impatiens amphorata Edgew.	G.		Him.
Impatiens aurea Muhl.	L.	Diur.	N. A.
Impatiens biflora Walt.	L.	Diur.	N. A.
Impatiens Noli-tangere L.	G. L.	Ir. Diur.	Eur. Siberia.

BEGONIACEAE

Begonia gracilis HBK.	G.	Em.	Mex.

BERBERIDACEAE

Berberis Aquifolium Pursh.	G. C. L.		N. Am.
Berberis aristata DC.	G. L.	F. P.	Ind.
Berberis vulgaris L.	G. L.	F. P. Ir.	Eur. Tem. As.
Caulophyllum thalictroides Michx.	G. L.	Sap.	N. Am.
Leontice Leontopetalum L.	G. L.	Ant. for	Italy Orient.
Nandina domestica Thunb.	G.	Opium	Japan China.
Podophyllum Emodi Wall.	L.	Cath.	Him. Reg.
Podophyllum peltatum L.	Sm. Rusby C. Ches.	Pur.	N. Am.

BETULACEAE

Betula lenta L.	Witthaus	Astr.	E. N. Am.
Betula lutea Michx.	Witthaus	Astr.	E. N. Am.

BIGNONIACEAE

Bignonia capreolata L.	G. R. L.	F. P.	N. Am.
Crescentia cucurbitina L.	G.		Tr. Am.
Crescentia Cujete L.	G.		Trop. Am.
Dolichandrona falcata Seem.	G.	F. P. Abort.	Ind.
Jacaranda procera Spr.	R.	F. P.	Guiana.
Osmohydrophora nocturna	G.	Hyd.	Braz.
Tanaecium crucigerum Seem.	G.		W. Ind.
Tecoma ceramensis Teijsm & Binn.	G.		Ceram Is.
Tecoma leucoxylon Mart.	G. R.	F. P.	Guiana W. Ind.
Tecoma obtusata DC.	G.		Brazil.
Tecoma radicans Juss.	G. R.	F. P.	N. Am.
Tecoma speciosa DC.	G.		Brazil.
Tecoma stans Juss.	G.		N. Am. S. Am.
Tecoma toxophora Mart.	G.		Brazil.

BIXACEAE

Gynocardia odorata R. Br.	G. L.	F. P.	Ind.
Hydnocarpus anthelminticum Pierce.	L.	Ant.	
Hydnocarpus castanea H. F. & Thoms.	G.	F. P.	Andoman Is. Malacca.

NAME OF PLANT	Authority	Properties	Locality
Hydnocarpus heterophylla Bl.	R.	F. P.	Java.
Hydnocarpus Kurzii	L.	Ant.	Trop. As.
Hydnocarpus piscidia	Sm.		
Hyndocarpus venenata Gaertn.	E. G. L. R.	F. P.	Zeylan.
Hydnocarpus Wrightiana Bl.	L. R.	Ant.	Ind.
Pangium edule Reinw.	G. R. E.	Hyd. F. P.	Java.
Taraktogenos Blumei Hassk.	G.	F. P.	Sumatra.
Trichadenia zeylanica Thw.	G.		Zeylan.
BORAGINACEAE			
Asperugo procumbens L.	Sm.		N. As. Eur.
Borago officinalis L.	Whi. C.	Ir.	Eur. Afr. As.
Bourreria Havanensis Miers.	G.		Cuba.
Cynoglossum officinale L.	G. L.	Ir.	Eur. Orient.
Echium vulgare L.	G.	Ir.	Eur. N. Am.
Heliotropium europaeum L.	G.		Eur. Afr. Ori. Austr. N. Am. Int.
BROMELIACEAE			
Ananas sativus Schult.	G. L.	Ant.	Tr. Am.
Bromelia Pinguin L.	G. L.	Sap.	Tr. Am.
Karatas Plumieri Emorr.	G.	Ant.	Panama.
BURMANNIACEAE			
Dipodium punctatum R. Br.	G. M.		Aust.
BURSERACEAE			
Canarium sp.	G.	F. P.	Aust. Pac. Is. Philipp.
Canarium commune Linn.	L.	Cath.	Molucca Is.
BUXACEAE			
Buxus balearica Lam.	G.	Cath.	Balearic Is.
Buxus sempervirens L.	Ches. G. C. L.	Ir.	Eur. Ori. Tem. As.
CACTACEAE			
Anhalonium Lewinii Henn.	G. L.	Card. Ineb. Nar.	Mex.
Cereus Bonplandii Parm.	L.	Card. Sed.	Brazil.
Cereus flagelliformis Mill.	G.	Ant.	S. Am.
Cereus grandiflorus Mill.	G. L.	Ir. Card. Sed.	W. Ind.
Cereus McDonaldii Hook.	L.	Card.	Honduras.
Echinocactus sp.	G.	Ir.	N. Am.
Echinocactus Williamsii Lem.	G. L.	Nar.	Mex. Tex.
Mammillaria sp.	G.		W. N. Am.
Rhipsalis sp.	G.		S. Am. Trop. Am.
CALYCANTHACEAE			
Calycanthus glaucus Willd.	G. L. Ches.	Sheep Poi.	N. Am.

CAMPANULACEAE (Including LOBELIACEAE)

NAME OF PLANT	Authority	Properties	Locality
Isotoma axillaris Lindl.	G. M.		Austr.
Isotoma Brownii G. Don.	M.		Austr.
Isotoma longiflora Presl.	G. M.		W. Ind.
Lobelia cardinalis L.	C. Mi. L. Rusby	Ant.	E. N. Am.
Lobelia fulgens Willd.	C. Mi.	Ac.	Eur.
Lobelia inflata L.	Sm. Ches. L. Rusby.	Dep. Em.	N. Am.
Lobelia Kalmii L.	Ches.		N. A.
Lobelia nicotianaefolia Heyne.	G.	Ac.	Ind.
Lobelia pratioides Benth.	G. M.	Acr.	Austr.
Lobelia rhynchopetalum Hemsl.	G.		Tr. Afr.
Lobelia siphilitica L.	Rusby. L. Ches.	Acr.	E. N. A.
Lobelia spicata Ruiz. & Pav.	Ches.		Peru.
Lobelia Tupa L.	G. R.	F. P.	Chili. Peru.
Lobelia urens Willd.	G. C.	Acr.	Eur.
Pratia erecta Gaud.	G. M.		Austr.
Siphocampylus giganteus Don.	G.		Equad.

CANELLACEAE

Canella alba Murr.	G. L.	Sap. F. P.	W. Ind.

CAPPARIDACEAE

Boscia urens Welw.	G.		Tr. Afr.
Cadaba indica Lam.	G.		Ind.
Capparis Cynophallophora L.	G. Sm. L.	Ant. Diur.	S. Am.
Capparis ferruginea L.	L.	Ant. Diur.	W. Ind.
Capparis globifera Del.	G.		Tr. Afr.
Capparis odoratissima Jacq.	G.		S. Am. Venez.
Cleome Chelidonii Lf.	G.		Ind. Java.
Cleome frutescens Aubl.	G.		Guiana.
Cleome gigantea L.	G.		Braz. S. Am.
Cleome graveolens Raf.	G.	Ir.	N. Am.
Cleome psoraleaefolia DC.	G.		Brazil.
Cleome rosea	G.	F. P.	Texas.
Cleome spinosa Jacq.	G.		S. Am.
Maerua angolensis DC.	G.		Tr. Afr.
Morisonia americana L.	G.		S. Am.

CAPRIFOLIACEAE

Abelia uniflora R. Br.	G.	Hyd.	China.
Diervilla japonica DC.	G.	Sap.	Japan.
Diervilla trifida Moench.	L.	Diur.	N. Am.
Lonicera chrysantha Turcz.	G.	Sap.	Siberia.
Lonicera involucrata Banks	G.	Sap.	N. Am. Ry. Mts.
Lonicera japonica Thunb.	G.	Sap.	Him. Reg.
Lonicera Standishii Hook.	G.		China.
Lonicera tatarica L.	G.	Sap.	Siberia.
Lonicera tomentella Hook f. & Thoms.		Sap	Him. Reg.
Lonicera Xylosteum L.	G.	Sap.	Eur. N. As.
Sambucus canadensis L.	C. Rusby L.	Em.	E. N. Am.
Sambucus Ebulus L.	G. C.	Sap.	E. Eur. Him. Reg.
Sambucus mexicana Presl.	L.	Em.	W. N. A.

NAME OF PLANT	Authority	Properties	Locality
Sambucus nigra L.	G.C. Rusby	Pur.	Eur. N. As.
Sambucus racemosa L.	G. C.		N. Tem. Reg.
Symphoricarpos mollis Nutt.	G.	Sap.	W. N. Am.
Symphoricarpos racemosus Michx.	G.	Ir.	N. Am.
Triosteum majus Michx.			E. N. Am.
Triosteum perfoliatum L.	G.Rusby L.	Cath.	N. Am.
Viburnum Lantana L.	G. L.	Astr.	Eur. Cauc. Reg.
Viburnum macrophyllum Thunb.	G.	Sap.	Japan.
Viburnum Opulus L.	G. L.	Sed.	Eur. As. N.Am.

CARYOPHYLLACEAE

NAME OF PLANT	Authority	Properties	Locality
Acanthophyllum C. A. Mey. sp.	G.		
Agrostemma Githago L.	G. C. Sm. Ches.	Sap. Ir.	Eur. As Int. N. & S. Am. Austr.
Arenaria serpyllifolia L.		Abort.	Eur.
Dianthus chinensis L.	G.	Sap.	Eur. Tem. As.
Gypsophila Struthium L.	G. L.	Sap.	Spain.
Herniaria glabra L.	G.	Sap.	Eur. N. As.
Lychnis chalcedonica L.	G.	Sap.	Japan.
Lychnis dioica L.	G.	Sap.	Eur. N. As.
Lychnis Flos-cuculi L.	G.	Sap.	Eur. N. As.
Lychnis indica Benth.	G.	Sap.	Him. Reg.
Polycarpaea sp.	G.	Sap.	Austr. Pac. Is. Trop.
Saponaria officinalis L.	G. C. L.	Ir. Sap.	Eur. W. As.
Saponaria Vaccaria L.	G.	Sap.	Eur. As. Min. Siber.
Silene antirrhina L.	Ches.		E. N. Am.
Silene Cucubalis Wibel.	G.		Eur. N. Afr. Him. Reg.
Silene Griffithii Boiss.	G.		Him. Reg.
Silene macrosolen Steud.	G.		Abyss.
Silene virginica L.	G.	Ant.	N. Am.
Silene viscosa Pers.	G.		Eur. N. Am.
Stellaria crassifolia Ehrh.	G.		N. & Arct. Reg.

CELASTRACEAE

NAME OF PLANT	Authority	Properties	Locality
Catha edulis Forsk.	G.	Stim.	Trop. Afr.
Celastrus scandens L.	Ches. L.	Em.	E. N. Am.
Elaeodendron orientale Jacq.	G.		Madag. Is. Maurit.
Euonymus atropurpureus Jacq.	G. L.	Em.	N. Am.
Euonymus Europaeus L.	G. C.	Em. Pur.	Eur. As. Min.
Euonymus latifolius Mill.		Em.	Eur. As. Minor.
Kurrimia zeylanica Arn.	G.	Hyd.	Zeyl.
Lophopetalum pallidum Laws.	G.		Malacca.

CHENOPODIACEAE

NAME OF PLANT	Authority	Properties	Locality
Atriplex Halimus L.	G.	Sap.	N. & S. Afr.
Atriplex hortensis L.	G. L.	Sap. Em.	Cosmop. Cult.
Atriplex laciniata L.	G.	Sap.	Eur. N. Am.
Atriplex Nuttallii S. Wat.	G.	Sap.	W. N. Am.
Atriplex rosea L.	G.	Sap.	Eur. N. Am. N. Afr. As. Minor.
Atriplex tatarica L.	G.	Sap.	Cent. As.
Atriplex vesicaria Hew.	G.	Sap.	Austr.
henopodium ambrosioides L.	G.Rusby L.	Ant.	Temp. & Trop.

NAME OF PLANT	Authority	Properties	Locality
			Reg. N. Am.
Chenopodium anthelminticum L.	Sm. L.	Ant.	Temp. & Tro Reg. N. Am.
Chenopodium Bonus-Henricus L.	L.	Ant.	Eu. N. Am.
Chenopodium Botrys L.	G. L.	Ant.	N. Reg. N.A Eur.
Chenopodium californicum S. Wat.	G.	Sap.	Cal.
Chenopodium hybridum L.	G.		N. Temp. Re N. Am. Eur.
Chenopodium mexicanum Moq.	G.	Sap.	Mex.
Chenopodium polyspermum L.	R.	F. P.	Eur. N. As.
Chenopodium rubrum L.	G.		Eur. N. As.
Chenopodium Vulvaria L.	Sm. L.	Ant.	Eur. N. Am.
Eurotia ceratoides C. A. Mey.	G.	Sap.	Cal. Eu. N. A W. N. Am.
Halocnemum fruticosum D. Dietr.	G.	Ant.	S. Eur. N. A
Kochia arenaria Roth.	G.	Sap.	S. Eur. W. A
Kochia scoparia Schrad.	G.	Sap.	Eur. W. As. N. Am.
Kochia trichophylla Hort.	G.	Sap.	
Salsola Kali L.	G.	Ant.	N. Eur. As. Am.
Salsola Kali var tenuifolia G. F.W. Mey.		Ir.	Eu. As. N. A
Salsola tamariscifolia Cav.	G.	Ant.	Eur.
Sarcobatus Maximilianii Nees.	Ches.	Tymp.	Ry. Mts. W N. Am.

CISTACEAE

COMBRETACEAE

Combretum bracteosum, Brandis	G.	Sap.	
Combretum erythrophyllum Sond.	G.		S. Afr.
Combretum phaneropetalum Bak.	G.		S. Afr.
Combretum racemosum Beauv.	G.		Trop. Afr.
Combretum trifoliatum Vent.	G.	Ant.	Hab.
Gustavia augusta L.	G. R.	F. P.	N. Granat.
Gustavia brasiliana DC.	G. R.	F. P.	Brazil
Quisqualis indica L.	G.	Ver.	Tr. As.
Terminalia Bellerica Roxb.	G. L.	F. P.	Ind. Malay
Terminalia Chebula Retz.	L.	Astr.	Tr. As.
Terminalia tomentosa Wight.	G.		Ind.

COMMELINACEAE

Athyrocarpus persicariaefolium Hemsl.	G.		Panama
Commelina deficiens Herb.	G.	Sap.	Braz.
Commelina nudiflora L.	G.		Tr. Reg.
Commelina tuberosa L.	G. L.		Mex.
Tradescantia crassifolia Cav.	P.		S. Am.
Tradescantia elongata G. F. W. Mey.	G.		S. Am.

COMPOSITAE

Achillea Ptarmica L.	C. L.	Acr.	N. Temp. Rg.
Anacyclus officinarum Hayne.	G. L.	Hyd.	S. Eur.
Anacyclus pedunculatus Pers.	G.	Ir.	Barbar.
Anacyclus Pyrethrum DC.	Sm. L.	Ir.	N. Afr. Ori t.
Anthemis aetnensis Schouw.	G.	Hyd.	Mt. Aetna
Anthemis altissima L.	G.	Hyd.	Eur. Orient

NAME OF PLANT	Authority	Properties	Locality
ithemis arvensis L.	G.	Hyd.	Eur. Orient.
ithemis austriaca Jacq.	G.	Hyd.	Eur. Orient.
ithemis Blancheana Boiss.	G.	Hyd.	Syria
ithemis chia L.	G.	Hyd.	Greece, As.Min.
ithemis Cota L.	G.	Hyd.	S. Eur.
ithemis Cotula L.	G. L.	Ir.	Eur. N. Afr. Orient.
ithemis elbuensis	G.	Hyd.	
ithemis montana L.	G.	Hyd.	Eur. Orient.
themis nobilis L.	L.	Naus. Stim.	Eu. As.
nica alpina Olin and Ladau.	L.	Nar.	Eur. N. A.
nica Chamissonis Less.	L.	Nar.	Unalaschk.
nica montana L.	G. Sm. L.	Pur. Ir. Nar.	Eur. N. A.
nica nudicaulis Ell.	L.	Nar.	N. A.
temisia Abrotanum L.	G. L.	Ineb.	Eur. Temp. A.
temisia Absinthium L.	G. C. L. Rusby	Incb. Nar. Ant.	Eur.
temisia arenaria DC.	Sm.	Ineb.	Cau. Reg.
temisia maritima L.	L. G.	Ineb. Ant.	Eur. Cauc. Sib.
temisia mexicana Willd.	G.	Ant.	Mex.
temisia pontica L.	L.	Ant.	Eur. Cau. Reg.
temisia trifida Nutt.	L.	Diaph.	W. N. A.
temisia vulgaris.	L.	Antisp.	Tem. Reg.
hanasia amara L.	G.	Ant.	
ractylis gummifera L.	G. C. L.		Med. Reg.
E charis cordifolia DC.	G. L.	Poi. Alk.	Brazil
rdopatium corymbosum Pers.	G.		As. Min. Med. Reg.
C lina acaulis L.	G. L.	Diur.	Eur.
C itaurea Calcitrapa L.	L.	Ir.	N. Af. Eur. Temp. As.
C itipeda orbicularis Lour.	G.	Ant	As. Austr. Pac. Is.
C ysanthemum Balsamita L.	G. L.	Ant.	W. As.
C ysanthemum cinerariaefolium Vis.	G. L.	Ins.	Dalmatia
C ysanthemum Parthenium Bernh.	G. C. L.	Ins. Ant.	Eur.
C ysanthemum pinnatifidum L.	G.	Cum.	Madera Is.
C ysocoma Coma—aurea L.	G.		S. Afr.
C adium Barbasco DC.	R. E.	F. P.	
C adium surinamense L.	G. R. E.	F. P.	S. Am.
C smos sulphureus Cav.	G.		Mex.
C pis lacera Ten.	G.		Italy
C iara Cardunculus L.	G.	Diur.	Med. Reg.
D iorphotheca Ecklonis DC.	G.	Hyd. Sap.	S. Afr.
D iorphotheca pluvialis Moench.	G.		S. Afr.
D ronicum pardalianches L.		Ir.	Eur. As.
D sodia papposa Hitch.		Ir.	N. Am.
E inops Ritro L.	G.		N. Am.
E phantopus tomentosus L.	G. L.	Em.	N. Am.
E tropappus glandolusus Less.	G.		S. Afr.
E patorium amarissimum	G.	Ins.	
E patorium cannabinum L.	G. L.	Diur.	Eur. N. As.
E ybia moschata	G.		
F veria Contrayerba Pers.	G.	Ant.	Trop. Am.
G phosis eriocarpa Benth.	G.		Austr.
G ndelia robusta Nutt.	G. L.	Antispas.	Cal.
G ndelia Tournefortii L.	G.	Em.	
H locarpha lyrata Hav.	G.		S. Afr.

NAME OF PLANT	Authority	Properties	Locality
Helenium autumnale L.	Ches. G. L.	Ir. Nar.	N. Am.
Helenium tenuifolium Nutt.	Ches. G. L.	Ir. Nar.	N.Am. S.States
Helianthus tuberosus L.	C.		N. Am.
Helichrysum apiculatum D. Don	G.	Ant.	Austr.
Hieracium virosum Pall.	G.		N. As. Eur.
Ichthyothere Cunabi Mart.	E. G. R.	F. P.	Brazil
Inula Royleana DC.	G.		Him. Reg.
Lactuca Scariola L.	G.C. Mi.L.	Nar.	E. Eur.
Lactuca taraxacifolia Schum.	G.	Nar.	Tr. Afr.
Lactuca tatarica C. A. Mey.	G.		W. As. In.
Lactuca virosa L.	G. Mi. L.	Nar.	Eur. N. As.
Launaea pinnatifida Cass.	G.		As. Trop. Afr.
Montanoa floribunda C. Koch.	G.		Mex.
Montanoa tomentosa Cerv.	G.		Mex.
Mutisia viciaefolia Cav.	G. L.	Sap. Sed.	Chili
Oldenburgia Arbuscula DC.	G.	Sap.	S. Afr.
Olearia macrodonta Bak.	G.	Sap.	N. Zeal.
Olearia moschata Hook.	G.		N. Zeal.
Onopordon Acanthium L.	G.		Eur. N. Afr. Orient.
Othonopsis intermedia Boiss.	G.		Persia
Parthenium Hysterophorus L.	L.		N. A. Aus.
Parthenium integrifolium L.	G.	Diur.	N. A.
Pentzia virgata Less.	G.		S. Afr.
Perezia oxylepis Sch.	G.		Mex.
Petasites officinalis Moench.	G.		Eur. N. As.
Picris hieracioides L.	L.	Bitter	Eur. Tem. As. Aus. N. Zea.
Prenanthes altissima L.	G. L.	Bitter	N. A.
Pterigeron adscendens Benth.	G. M.		Aus.
Pterocaulon pycnostachyum Ell.	G.	Nar.	N. A.
Pulicaria dysinterica Gaertn.	L.	Ins.	Eur.
Senecio gaudalensis.	Ches.		Mex.
Senecio Grayanus Heimsl..	G.	Abort.	Mex.
Senecio Jacobaea L.	G. L. Ches	Anodyne	Eur. N. As. N.
Senecio toluccanus DC.	G.		Mex.
Senecio vulgaris L.	G. L.	Astr.	Eur.
Senecio vulneraria DC.	G.		Mex.
Silybum Marianum Gaertn.	L.	Exp.	Eur.
Solidago Virgaurea L.	G. L.	Diur.	N. Tem. Reg.
Spilanthes Acmella Murr.	G. L.	Pung.	Cosm. Trop. & Sub-trop.
Spilanthes oleracea L.	L.	Pung.	S. A.
Tanacetum umbelliferum Boiss.	G.	Abort.	Afghan.
Tanacetum vulgare L.	G.Rusby L.	Abort.	Eur. N. As.
Vernonia anthelmintica Willd.	G. L.	Ant.	Him. Reg.
Vernonia nigritiana Oliv. and Hiern.	G.		Tr. Afr.
Xanthisma texanum DC.	G.	Sap.	Texas
Xanthium canadense Mill.	G. Ches.	Mech.	N. Am.
Xanthium spinosum L.	G. Ches.		Cosm.
Xanthium Strumarium L.	G. Ches.		Cos.

CONIFERAE

Cephalotaxus drupacea Sieb and Zucc.	G.		Jap.
Ginkgo biloba L.	G.	Acr.	Jap.
Juniperus Sabina L.	C.G. Mi.L.	Abort.	Eur. N. As
Juniperus oxycedrus L.	Sm.	Abort.	S. Eur. Cauc. Reg.

NAME OF PLANT	Authority	Properties	Locality
Juniperus virginiana L.	C. L. G. Mi.	Abort.	E. N. A.
Picea excelsa	White	Ir.	Eur. Cult. N. Am.
Pinus Laricio Poir.	Sm.	Ineb.	S. Eur.
Pinus sylvestris L.	Sire	Ineb.	Eur. N. As.
Sequoia sempervirens Endl.	G.		Cal.
Taxus baccata L.	Mi. R. L.	F. P.	Eur.
Taxus brevifolia Nutt.		Astr.	W. N. A.
Taxus canadensis Marsh.	Ches. Wh. L.	Astr.	E. N. Am.
Thuja occidentalis L.	G. L.	Abort.	N. A.
Torreya nucifera Sieb. and Zucc.	G.		Jap.
Tsuga cannadensis	Wh. L.	Astr.	N. N. Am.
CONNARACEAE			
Agelaea emetica H. Bu.	G.		
Cnestis corniculata Lam.	G.		Trop. Afr.
Cnestis glabra Lam.	G.		Mas. Is.
Cnestis polyphylla Lam.	G.		Mad. Maurit.
Cnestis glabara Lam.	G.		Trop. Afr.
Connarus africanus	G.		Trop. Afr.
Rourea glabra HBK.	G.	Con.	Venez.
CONVOLVULACEAE			
Convolvulus Scammonia L.	C. Sm. L.	Cath.	As. Minor
Convolvulus sepium L.	C.		Eur. N. A.
Convolvulus venenatus West.	G.		St. Croix Is.
Cuscuta americana L.	G.		N. A.
Cuscuta australis R. Br.	G.	A. P.	Aus.
Cuscuta Dorycnium L.	G.		
Cuscuta epithymum Murr.	Sm.	Cath.	Eur. N. As. N. Am.
Cuscuta europaea L.	Sm.	Cath.	Eur. Orient. N. Am.
Ipomoea emetica Choisy.	G.	Em.	Mex.
Ipomoea Jalapa Coxe.	C.	Em.	Mex.
Ipomoea pandurata G. F. W. Meyer.	Rusby	Pur.	S. E. U. S.
Ipomoea Purga Hayne.	Sm.	Pur.	Mex.
Ipomoea sinuata Orteg.	G.	Em.	Am. Calid.
Ipomoea tuberosa L.	G.		Trop. Reg.
CORIACEAE			
Coriaria myrtifolia L.	G. C. L.		Med. Reg.
Coriaria naepalensis Wall.	G.		Him. China
Coriaria ruscifolia L.	G.		Peru
Coriaria sarmentosa Frost.	G. L.		N. Zeal.
Coriaria thymifolia Humb. & Bonpl.	G.		Peru
CORNACEAE			
Alangium Lamarckii Thwait.	G.		Cosm. Trop.
Amyris balsamifera L.	G.	Ir.	Jamaica
Aucuba japonica Humb.	Sm.	Exp.	Japan
Cornus Amomum Mill.	G. L.	Exp.	E. N. Am.
Cornus circinata L. Her.	L.	Astr.	N. A.
Cornus Mas. L.	L.	Astr.	N. A.
Cornus paniculata L. Her.	Pammel	Exp.	E. N. Am.
Garrya Fremontii Torr.	G. L.		W. N. Am.
Marlea Vitiensis Benth.	G.		Austr. Pac. Is.

CRASSULACEAE

NAME OF PLANT	Authority	Properties	Locality
Cotyledon ventricosa Burm.	G.		Afr. Austr.
Kalanchoe spathulata DC.	G.		
Sedum acre L.	G. Mi. L.	Ir.	Trop. As.
Sempervivum montanum L.	G.	Ir.	Eur. N. As. N. Am. Cent. Eur.

CRUCIFERAE

Barbarea vulgaris R. Br.	G. L.	Antisc.	Eur. Temp. As. N. Am.
Brassica alba Boiss.	Sm.	Ir.	Eu. As. N. Am.
Brassica arvensis L.	C. L.	Ir. Em.	Eu. As. N. Am.
Brassica nigra Koch.	C. L.	Ir. Em.	Eu. As. N. Am.
Capsella Bursa-pastoris Medic.	G.	Sap.	Temp. Reg.
Cardamine amara L.	G.		Eur. N. As.
Cardamine pratensis L.	G. L.	Antisc.	Temp, Reg.
Crambe filiformis Jacq.	G.		Pat. Chili
Diplotaxis erucoides DC.	G. L.	Ir.	Med. Reg. As. Minor
Diplotaxis tenuifolia DC.	L.	Ir.	Eur.
*Eruca sativa Mill.	Wilcox*		Med. Reg. W. As. N. Am.
Erysimum cheiranthoides L.	Sm. L.	Ir. Ant.	Eur.
Erysimum crepidifolium Reichb.	G.		Eur.
Isatis corniculata	G.		
Lepidium Draba L.	G. R.	F. P.	Eur. Orient.
Lepidium latifolium L.	Sm.	Ir.	Eur. As.Orient.
Lepidium oleraceum Forst.	G. L.	F. P.	N. Zeal.
Lepidium Owaihiense Cham. & Schlecht.	G.	F. P.	Hawai. Is.
Lepidium piscidium Forst.	G. R.	F. P.	Pac. Is.
Lepidium sativum L.	G. Whi. L.	Ir.	Orient.
Matthiola livida DC.	G.		Egypt, Arab.
Radicula Armoracia (L.) Robinson.	Antisc.	Ir.	Eur.As. N. Am.
Raphanus Raphanistrum L.	C. L.	Ir.	Eur.
Raphanus sativus L.	L.	Antisc.	Asia
Senebiera pinnatifida DC.	G.		Cosmop.
Sisymbrium Alliaria Scop.	C.		Eur. Orient. Him. Reg.
Sisymbrium Sophia L.	G.		Temp. Reg.
Sisymbrium officinale (L.) Scop.	L.	Antisc.	Eur. N. As.
Sisymbrium toxophyllum G. A. Mey.	G.		N. As.
Vesicaria gnaphalodes Boiss.	G.		Persia

CUCURBITACEAE

Bryonia alba L.	Mi. C. L.	Ir.	
Bryonia dioica Jacq.	G.Mi. C.L.	Ir.	Eur. Med. Reg.
Cayaponia ficifolia Cogn.	G.		Brazil
Citrullus Colycinthis Schrad.	G. C.	Pur.	Afr. Calid.
Corallocarpus epigaeus B. & H.	L.	Ant.	E. Ind.
Cucumis africanus Lindl.	G.	Em.	S. Afr.
Cucumis dipsaceus Ehrenb.	G.		Arab. Trop.Afr.
Cucumis metuliferus E. Mey.	G.		S. Afr.
Cucumis myriocarpus Naud.	L.	Em	S. Afr.
Cucumis prophetarum L.	L.	Pur.	Arabia.

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*A case of probable poisoning of sheep by this weed was reported to Dr. Wilcox from Nebraska.

NAME OF PLANT	Authority	Properties	Locality
Cucumis Sacleuxii Hort.	G.	Sap.	
Cucumis trigonus Roxb.	G. L.	Ant.	Ind.
Cucurbita maxima Duchesne	G.	Sap.	
Ecballium elaterium A. Rich.	C. Sm. L.	Pur.	Med. Reg.
Echinocystis fabacea Naud.	G. L.	Sap.	Calif.
Echinocystis macrocarpa Greenee		Sap.	Calif.
Fevillea cordifolia L.	G. L.	Em.	Ind.
Lagenaria vulgaris Ser.	G. L.	Sap.	Trop. Reg.
Luffa acutangula Roxb.	G.		Trop. old world
Luffa aegyptiaca Mill.	G.		Trop. old world
Luffa purgans Mart.	L.	Cath.	Tr. Am.
Melothria scrobiculata Cogn.	G.	Taen.	Abyss.
Momordica Balsamina L.	L.	Em.	Trop. Reg.
Momordica Charantia L.	L.	Ant. Em.	Trop. Reg.
Momordica cochinchinensis Spreng.	G.		Trop. As.
Momordica Cymbalaria Fenzl.	G.		Trop. Afr.
Sicydium monospermum Cogn.	G.	Em.	Brazil
Telfairia pedata Hook.	G.	Taen.	Trop. Afr.
Trichosanthes Celebica Cogn.	G.		Celebes.
Trichosanthes globosa Bl.	G.	F. P.	Java
Trichosanthes pubera Blum.	G.		Ind. Malay
Trichosanthes trifoliata Bl.	G.		Malay
Trichosanthes wallichiana Cogn.	G.		Ind.

CYCADACEAE

Callitris sp.	G.		Austr.
Cycas circinalis L.	G.		Molucc. Is.
Cycas media R. Br.	G. M.		Austr.
Macrozamia sp.	G. M.		Austr.
Zamia media Jacq.	G.		W. I.

CYPERACEAE

Cyperus articulatus L.	G. L.	Ant.	Cosmop. Trop.
Kyllingia monocephala Rottb.	G.		Trop. old world
Schoenus apogon Roem. and Schult.	M.		Austr. N. Zeal.

CHAILLETIACEAE

Chailletia cymosa Hook.	G.		S. Afr.
Chailletia toxicaria Don.	G. R.	F. P.	Trop. Afr.
Tapura guianensis Aubl.	G. R.	F. P.	Guian.

DILLENIACEAE

Davilla rugosa Poir.	G.		Brazil
Doliocarpus Rolandri J. F. Gmelin.	G.		Guiana, Brazil.
Hibbertia glaberrima F. Muell.	G. M.		Austr.
Hibbertia longifolia F. Muell.	G.		Austr.
Tetracera alnifolia Willd.	G. R.	F. P.	Tr. Afr.
Tetracera Assa DC.	E.	F. P.	Ind. Malay

DIOSCOREACEAE

Dioscorea sp.	G.		
Dioscorea alata L.	G.		Tr. As.
Dioscorea bulbifera L.	G.		Tr. As.
Dioscorea deltoidea Wall.	G.		Ind.

NAME OF PLANT	Authority	Properties	Locality
Dioscorea hirsuta Mart.	G.		Mex.
Dioscorea macroura Harm.	G.		
Dioscorea toxicaria Bojer.	G.		Tr. Afr.
Dioscorea triphylla Schimp.	G.		Abyss.
Tamus communis L.	G. C. L.	Ir. Diur.	Eur. Persia. Afr.

DIPSACEAE

Scabiosa Succisa L.	Sm. L.		Eur. Tr. N. A. & S. A.

DIPTEROCARPACEAE

Ancistrocladus Vahlii Arn.	G.		Zeylan.
Dryobalanops camphora	Sm. L.	Del.	Zeylan.

DROSERACEAE

Dionaea muscipula Ellis.	G. Sm. L.	Ir. Hyd.	N. Am.
Drosera binata Labill.	G.	Hyd.	Austr. N. Zeal.
Drosera communis S. Hil.	G.		Brazil
Drosera intermedia Hayne.	G.	Hyd.	Eur.
Drosera peltata Sw.	G. M.		Austr.
Drosera rotundifolia L.	G Sm. L.	Ir. Hyd.	N. Reg.
Drosera Whittakerii Planch.	M.		Austr.
Drosophyllum lusitanicum Link.	G.	Hyd.	Lusitan. Morocco.

EBENACEAE

Diospyros acris Hemsl.	G.	Acr.	Solomon Is.
Diospyros amara	G.		
Diospyros Ebeneum Koen.	G. L. R.	Astr. F. P.	Ind. Malay
Diospyros embryopteris Pers.	L.	Astr.	Tr.Afr.Philipp.
Diospyros malacapai A. DC.	G.		Trop. As.
Diospyros montana Roxb.	G.		Philipp.
Diospyros multiflora Blanco.	G.	F. P.	N. A.
Diospyros obtusifolia Willd.	L.	Astr.	
Diospyros samoensis A. Gr.	G.	F. P.	Samoa Is. Nav.
Diospyros tesselaria Poir.	G.	F. P.	Mascar. Is.
Diospyros toxicaria Hiern.	G.		Madagascar
Diospyros virginiana L.	G. L.	Ant. Astr.	N. A.

EQUISETACEAE

Equisetum arvense L.	G. Mi. L. Ches.	Diur.	Eur. N. A.
Equisetum hyemale L.	L.	Diur.	Eur. As. N. A.
Equisetum palustris L.	Ches.	Diur.	Eur.

ERICACEAE

Andromeda Polifolia L.	Ches.	Nar.	E. N. Am. Eur. As.
Arbutus Andrachne L.	G.	Nar.	Med. Reg.
Arbutus Unedo L.	G. L.		Med. Reg.
Arbutus varians Benth.	G.		Mex.

NAME OF PLANT	Authority	Properties	Locality
Arbutus xalapensis H. B. K.	L.	Diur. Nar.	Mex. S.W.U.S.
Arctostaphylos polifolia H. B. K.	G.	Nar.	Mex.
Arctostaphylos Uva-ursi L.	Sm. L.	Ir. Diur.	Eur. N. A.
Epigaea repens L.	Ches.	Nar.	E. N. Am.
Gaultheria microphylla Hook.	G.		Magellan Reg.
Gaultheria numularoides D. Don.	G.		Him. Reg. Java
Gaultheria procumbens.	G. L.	Astr.	E. N. A.
Kalmia angustifolia L.	G. Rusby L. Ches.	Nar. Astr.	E. N. A.
Kalmia glauca Ait.	L.	Nar.	E. N. A.
Kalmia hirsuta Walt.	L.	Nar.	E. N. A.
Kalmia latifolia L.	G. Ches. L. Rusby	Nar. Astr.	E. N. A.
Ledum glandulosum Nutt.	L. Ches.	Nar.	N. and Arc.Reg.
Ledum latifolium Jacq.	C. Ches. L. Rusby	Nar.	N. N. A.
Ledum palustre L.	G. C. Rusby L.	Nar.	N. & Arc. Reg
Leucothoe Catesbaei A. Gr.	C. L. Ches.	Errhine.	N. A. S. States
Leucothoe racemosa A. Gray.	Ches.	Errhine.	
Oxydendron arboreum DC.	Whi. L.	Ir.	N. A.
Pieris floribunda Benth. & Hook.	Ches.	Ineb.	N. A.
Pieris mariana Benth. & Hook.	G. Rusby L. Ches.	Ineb.	E. N. A.
Pieris nitida Benth. & Hook.	G. L.	Ineb.	E. N. A.
Pieris ovalifolia D. Don.	G.		Him. Reg. Java
Rhododendron arborescens Torr.	C.	Nar.	N. A.
Rhododendron arboreum Sm.	Sm. G.	Nar.	Ind. Him. Reg.
Rhododendron californicum Hook.	Ches.	Nar.	N. A. Calif.
Rhododendron campanulatum D. Don.	G.	Nar.	Him. Reg.
Rhododendron catawbiense Mx	L.	Nar.	E. N. A.
Rhododendron caucasicum Pall.	G.	Nar.	Caucas.
Rhododendron chrysanthum Pall.	G. Sm. L.	Nar.	Davur.
Rhododendron cinnebarinum Hook.	G.	Nar.	Him. Reg.
Rhododendron dauricum L.	G. R.	Nar. F. P.	Eur. As.
Rhododendron ferrugineum L.	G. C. Sm.L.	Nar.	Eur. As.
Rhododendron hirsutum L.	G. C.	Nar.	Eur.
Rhododendron indicum Sw.	C.	Nar.	China
Rhododendron ledifolium G. Don.	C.	Nar.	China
Rhododendron maximum L.	G. Ches. C. Rusby L.	Nar.	E. N. A.
Rhododendron nudiflorum Torr.	C.	Nar.	N. A.
Rhododendron occidentale A. Gray.	Ches.	Nar.	W. N. A.
Rhododendron ponticum L.	G. C. Sm.	Nar.	A. M.
Rhododendron punctatum Andr.	C.		N. A.
Rhododendron sinense Sw.	C.	Nar.	Japan
Rhododendron sublanceolatum Miq.	C.	Nar.	Japan
Zenobia speciosa D. Don.	G.		N. A.

ERYTHROXYLACEAE

Erythroxylon coca Lam.	Sm. L. G.	Del. Stim. Anes.	Peru

EUPHORBIACEAE

Acalypha colchica Fisch. & Mey.	G.	Hyd.	Caucas.
Acalypha cordifolia Muell.	G. Wat.		Him. Reg.
Acalypha indica L.	G.	Em.	Tr. As. & Afr.
Acalypha virginica L.	L.	Exp.Diur.Ir	N. Am.

NAME OF PLANT	Authority	Properties	Locality
Baliospermum axillare Bl.	G.		Ind. Malay
Beyeria viscosa Miq.	G. M.		Aus.
Bridelia retusa Spreng.	G.		Ind. Malay
Chrozophora plicata A. Juss.	G.		Eur.Afr.As.Ind.
Chrozophora tinctoria A. Juss.	G.		Eur. Ori. Ind.
Cleistanthus collinus Benth. & Hook.	G.		Afr.
Cnesmone javanica Bl.	G.		Ind.
Croton muricatus Zipp.	G.		Java
Croton Tiglium L.	G.C. Sm.R. L.	Pur. F. P.	Timor. Is. Ind. Malay
Croton Verreauxii Baill.	G.		Austr.
Daphniphyllum bancanum Kurz.	G.		Java
Eloeococca verrucosa	C.		
Eremocarpus setigerus Benth.	L.	A. P. F. P.	Calif.
Euphorbia aleppica L.	R.	Ir. F. P.	
Euphorbia alsinaeflora Baill.	G. M.	Ir.	Austr.
Euphorbia amygdaloides L.	G. R.	Ir. F. P.	Eur. Orient.
Euphorbia antiquorum L.	G.	Ir.	Ind.
Euphorbia arborea		Ir.	
Euphorbia bicolor Engem & Gray.	Ches.	Ir.	N. Am.
Euphorbia candelabrum Trem.		Ir.	
Euphorbia caracasana	R. G.	Ir. F. P.	
Euphorbia cerebrum L.	G.	Ir.	
Euphorbia chamalsyce L.	G.	Ir.	
Euphorbia characias L.	G.	Ir.	Med. Reg.
Euphorbia corollata L.	L.	Ir.	N. A.
Euphorbia cotinoides Miq.	G. R.	Ir. F. P.	Guiana
Euphorbia cotinifolia L.	G. E. R.	Ir. F. P.	Ind.
Euphorbia Cyparissias L.	Mi. C.	Ir.	Eur. N. Am.
Euphorbia dendroides L.	G. R.	Ir. F. P.	Med. Reg.
Euphorbia Drummondii Boiss.	G. M.	Ir.	Austr.
Euphorbia eremophila A. Cunn.	Mi.	Ir.	Austr.
Euphorbia Esula L.	R. Mi. E.	Ir. F. P.	Eur.
Euphorbia Gerardiana Jacq.	Mi. C.	Ir.	Eur.
Euphorbia helioscopia L.	Mi. C.	Ir.	Eur. and N. As.
Euphorbia heptagona L.	G.	Ir.	S. Afr.
Euphorbia heterodoxa Muell.	L.	Acr.	Brazil
Euphorbia hyberna L.	G. R.	Ir. F. P.	Eur.
Euphorbia Ipecacuanhae L.	M. Rusby L.	Ir.	N. A.
Euphorbia Lathyris L.	C. R. Ches. L.	Ir. F. P. Ir.	Eur. N. Am.
Euphorbia linearis Retz.	G.	Ir.	W. I.
Euphorbia lingularia	G.	Ir.	
Euphorbia marginata Pursh.	G. Ches.	Ir.	N. Am.
Euphorbia mellifera Ait.	G.	Ir.	Madeira Is.
Euphorbia neriifolia L.	G. R.	Ir. F. P.	Ind. Malay
Euphorbia officinarum	Sm.	Ir.	N. Afr.
Euphorbia palustris L.	G. Mi. C.	Ir.	Eur.
Euphorbia Paralias L.	Mi.	Ir.	Med. Reg.
Euphorbia Peplus L.	Mi. C. Sm.	Ir.	Eur. N. As.
Euphorbia piscatoria Ait.	G. E. R.	Ir. F. P.	Mader. Is.
Euphorbia pithyusa L.	Mi.	Ir.	Med. Reg.
Euphorbia platyphyllos L.	G.	Ir.	Eur. Afr.
Euphorbia Preslii Guss.	Smi.	Ir.	N. Am.
Euphorbia primulaefolia Baker	G.	Ir.	Madagas.
Euphorbia pulcherrima Willd.	G.	Ir.	Mex.
Euphorbia punicea Sw.	G. E.	Ir. F. P.	Jamaica
Euphorbia pungiformis Boiss.	G.	Ir.	

NAME OF PLANT	Authority	Properties	Locality
Euphorbia Regis-Jubae Webb. & Benth.	G.	Ir.	Teneriff Is.
Euphorbia resinifera Berg.	L.	Ir.	Morocc.
Euphorbia Royleana Boiss.	G. R.	Ir. F. P.	Him. Reg.
Euphorbia Sibthorpii Boiss.	G. R.	Ir. F. P.	Greece
Euphorbia Sieboldiana Moor. & Decne.	G.	Ir.	Japan
Euphorbia thymifolia L.	G.	Ir.	Tropics
Euphorbia Tirucalli L.	G. R.	Ir. F. P.	Afr. Ind.
Euphorbia venefica Trem.	G.	Ir.	Tr. Afr.
Euphorbia verrucosa Lam.	Mi. C.	Ir.	Eur.
Euphorbia Wulfenii Hoppe.	G.	Ir.	Dalmatia
Excoecaria Agallocha L.	G. R. M. C. L.	Acr. F. P.	Tr. As. Malay Pac. Is.
Excoecaria virgata Zoll and Mor.	G.		Java
Fluggea Leucopyrus Willd.	G. R. E.	F. P.	Ind.
Fluggea obovata Baill.	G.		Tr. Afr.
Gymnanthes lucida Sw.	Sm.		W. Ind.
Hippomane Mancinella	L. G. Sm.	Ir.	Ind.
Homalanthus crepitans L.	E.&G. C.R.	F. P.	
Homalanthus Leschenaultianus A. Juss.	G. M.		Ind. Malay Austr.
Hyoemanche globosa	C.		
Jatropha Curcas L.	G. C. R. L.	F. P.	Tr. Amphig.
Jatropha glandulifera Roxb.	G.		Tr. As. & Afr.
Jatropha macrorhiza Benth.	G.		Mex.
Jatropha multifida L.	G.	Ir.	Tr. Amphig.
Jatropha urens L.	G. Sm. Ches.	Ir.	Tr. Am.
Joannesia princeps Vell.	G. L. E.	Cath. F. P.	Braz.
Macaranga sp.	G.		Java
Mallotus philippinensis Muell.	Sm. L.	Pur.	As. Astr.
Manihot Glaziovii Muell.	G.		
Manihot utilissima Pohl.	R. G. Wh. Sm. C. L.	F. P. Hyd.	Braz.
Mecurialis annua	C. L.	Cath. Ir.	Eur.
Mecurialis perennis L.	G. C. L.	Ir. Cath.	Eur.
Mecurialis tomentosa	C.		
Pedilanthus tithymaloides Poit.	G. L.	Ir. Em.	Mex. S. Am.
Petalostigma cordifolia Fv. M.	G.		
Phyllanthus Conami Sw.	E. G. Sm. Mi.	F. P.	Tr. Am.
Phyllanthus Emblica L.	G.		Tr. As.
Phyllanthus epiphyllanthus L.	G.		Cuba.
Phyllanthus Gasstromi Muell.	G. M.		Austr.
Phyllanthus lacunarius F. M.	G. M.		Austr.
Phyllanthus Niruri L.	G.		Tr. Reg.
Phyllanthus piscatorum H. B. & K.	G. Mi. E.		Venezuela
Phyllanthus urinaria L.	G.	F. P.	Tr. Amphig.
Piranhea trifoliata Baill.	G. Mi.		Braz.
Platygyna urens Mercier		F. P.	
Putranjiva Roxburghii Wall.	G.		Ind. Burma
Ricinus communis L.	G.Sm. C.L. Ches.	F. P. Pur.	Tr. Reg.
Sapium indicum Willd.	G. Mi. E.	F. P. Nar.	Ind.
Sapium insigne Trim.	G.	Ir.	Ind.
Sebastiana Palmeri Riley.	G.		
Sebastiana Pavoniana Muell. Arg.	G.		
Securinega ramiflora Muell. Arg.	G.	Hyd.	As.
Stillingia lineata Muell.	G.		Ind. Maurit.

NAME OF PLANT	Authority	Properties	Locality
Stillingia sylvatica L.	L.	Expect.	U. S.
Toxicodendrum globosum	G.	Con.	
Tragia cordifolia Vahl.	G.	Ves.	Arabia
Tragia involucrata L.	G.	Ves.	Tr. As.
Tragia volubilis L.	G. L.	Ves.	Ind.

FAGACEAE

NAME OF PLANT	Authority	Properties	Locality
Castanopsis Tungurrut A. D C.			Malay
Fagus sylvatica L.	C. Mi.	Gastr.	Eur.
Quercus alba L.	L.	Astr. Tymp.	E. N. A.
Quercus Toza Gillet	C.		S. Eur.
Quercus lusitanicus Lam.	L.	Astr.	Med. Reg.
Quercus sp.	Ches.		

FICOIDEAE

NAME OF PLANT	Authority	Properties	Locality
Aizoon canariense L.	G.		Canar. Is. Afr. Orient.
Gisekia pharnacioides L.	G.	Taen.	Taen. Ind.
Limeum sp.	G.		S. Afr.
Mesembryanthemum anatomicum Haw.	G.	Nar.	Tr.Reg & Sub. Tr. Reg. Afr.
Mesembryanthemum crystallinum L.	L.	Diur.	Gr. Can. Is. S. Afr. Calf.
Mollugo hirta Thunb.	G. M.		Austr.
Tetragonia expansa Thunb.	G.	Sap.	Japan
Trianthema sp.	G.	Sap.	Arab. Afr. Austr.
Trianthema Portulacastrum L.	G.	Sap. Par.	Tr. Am.

FILICALES

NAME OF PLANT	Authority	Properties	Locality
Adiantum pedatum L.	G.	Astr.	E. As. Jap. N. A.
Adiantum peruvianum Kl.	G.		Peru
Adiantum trapeziforme L.	G.		Trop. Am.
Anemia oblongifolia Sw.	G.		Trop. Am.
Angiopteris erecta Hoffm.	G.		
Aspidium athamanticum Ktze.	G. L.	Ant.	S. Afr.
Aspidium Filix-Mas Sw.	G. L.	Ant.	Eur. N. A.
Aspidium marginale Ktze.	G. L.	Ant.	Eur. N. A.
Aspidium odoratum Willd.	G.		N. Ind. E. As.
Aspidium prestulatum Ten.	G.	An.	
Aspidium rigidum Sw.	G.		
Ceterach officinarum Willd.	G. L.	Abort.	Eu. Ind.
Cheilanthes fragrans	G.		Med. Reg. Him. Reg.
Cryptogramme crispa R. Br.	G.		N. Eur. N. W. Am.
Cystopteris alpina Desv.	G.	Hyd.	Eur. Mt. Reg.
Cystopteris bulbifera Bernh.	G.	Hyd.	N. Am.
Cystopteris fragilis Bernh.	G. L.	Hyd.	Eu. N. Am. Cosm.
Cystopteris montana Bernh.		Hyd.	Cent. Eur. E. Malay, Trop.
Davallia brasiliensis Hook.	G.	Hyd.	As. Austr.
Davallia elegans Sw.	G.	Hyd.	N. A. S. A.

NAME OF PLANT	Authority	Properties	Locality
Davallia hirsuta Kaulf.	G.	Hyd.	Japan
Davallia majuscula Lowe	G.	Hyd.	Ceylon
Davallia pentaphylla Don.	G.	Hyd.	Java & adj. Is.
Davallia platyphylla Don.		Hyd.	Ind.
Davallia strigosa Sw.	G.		N. Ind. Japan, Malay
Geniophlebium incanum Sw.	G.		
Gleichenia flabatellata R. Br.	G.	Sap.	
Gymnogramme cordata Schl.	G.		S. Afr.
Lindsaea cultrata Bl.	G.		N. Ind. Malay
Polypodium laciniatum Bl.	G.		Mad. Austr.
Polypodium ligulatum Sw.	G.		Java
Polypodium percussum Cav.	G.		S. A.
Polypodium Phymatodes L.	G.		Malay, Ceylon, Austr.
Polypodium scandens Forst.	G.		N. Z. Austr.
Polypodium suspensum L.	G.		Trop. Am.
Polypodium vulgare L.	L.	Exp. Diur.	Eu. N. Am.
Polystichum spinulosum DC.	G.		N. Am.
Pteris aquilina L.	G.	Hyd. Ant.	Coc.Eu. N.Am.
Pteris caudata L.	G.	Ant.	

FLAGELLARIACEAE

Susum anthelminthicum Bl.	G.		Java

FRANKENIACEAE

Frankenia ericifolia Chr.	Sm. G.	F. P.	Canary Is.
Frankenia grandifolia Cham. & Schlecht.	L.	Astr.	Calif.

FUMARIACEAE

Corydalis racemosa Pers.	G.		Japan
Dicentra canadensis Walp.	L.	Diur.	N. A.
Fumaria officinalis L.	G. L.	Nar.	Temp.old world
Fumaria spicata L.	G.		Lusitan.

GENTIANACEAE

Gentiana verna L.	G.		Eur. Cauc. Reg.
Menyanthes trifoliata L.	G.		N. Temp. Reg.
Tachia guianensis Aubl.	G.		Guian.

GERANIACEAE

Erodium cicutarium			Eu. N. Am. S. Am.
Pelargonium peltatum Ait.	G.		S. Afr.

GNETACEAE

Ephedra L.	G.		Eur.
Ephedra antisyphilitica C. A. Mey.	L.	Astr.	N. A. Mex.
Gnetum scandens Roxb.	G.	F. P.	Ind. Malay
Gnetum urens Blum.	G.	Ur.	Guian.

GOODENIACEAE

Goodenia grandiflora Sims.	G.		Austr.
Scaevola sp.	G.	A. P.	Austr.
Velleia paradoxa R. Br.	G. M.		Austr.

GRAMINEAE

NAME OF PLANT	Authority	Properties	Locality
Agrostis alba L.	*Hell.	Ur.	N. Temp. Reg.
Andropogon annulatus Forsk.	G.		Afr.Ind. Austr.
Andropogon halepensis		Hyd.	Eur. Afr.N.Am.
Anthistiria prostrata Willd.			Ind.
Anthoxanthum odoratum L.	G.	Cou.	Eur. As. Afr.
Arrhenatherum avenaceum Beauv.	G.	Sap.	Eur.
Avena fatua L.	G.	Mech.	Eur. Ori. As.
Briza sp.	G.	Hyd.	S. Am. Eur. N. Am. As.
Bromus catharticus Vahl.	G.		
Bromus mollis L.	G.		Eur. Afr. As.
Bromus secalinus L.	G.		Eur. Med. Reg. As.
Bromus tectorum L.	Pa.	Ir.	Eu. N. Am.
Catabrosa sp.	G.	Hyd.	
Cenchrus tribuloides L.	G.	Mech.	N. Am.
Cortaderia argentea Stopf.	G.		
Cortaderia conspicua	G.	Hyd.	
Cortaderia Kermesiana	G.	Hyd.	
Deyeuxia Langsdorffii Kunth.	G.	Sap.	N. Am.
Elionurus sp.	G.		S. Af. S. Am. Austr.
Elymus sp.	G.	Hyd.	Eur. N. Am.
Festuca sp.	G.	Hyd.	
Festuca quadridentata H. B. & K.	G. C.		Equador
Glyceria sp.	G.	Hyd.	N. Am. Eur.
Glyceria aquatica Wahleb.	G.	Hyd.	N. Tem. Reg.
Heteropogon hirtus Pers.			Tr. Reg.
Hierochloe australis R. & S.	G.	Cou.	Eur.
Hierochloe borealis Roem. & Schult.		Cou.	N. Reg.
Hierochloe rariflora Hook.	G.	Cou.	Eur.
Holcus sp.		Hyd.	Eur. N. Am.
Lolium Lamarckii L.	G. C.	Hyd. Del.	Eur. As.
Lolium perenne L.	G. C. Mi.	Hyd.	Eur. As.
Lolium temulentum L.	L. Ches.	Nar. Intox.	Eur. As. U. S.
Melica sp.	G.	Hyd.	
Milium effusum L.	G.		N. Temp. Reg.
Molinia caerulea Moench.	G. C.		Eur. As.
Panicum	G.	Hyd.	N. Temp. Reg.
Panicum junceum Nees.	G.	Hyd.	Braz.
Panicum sanguinale L.	G.	Em.	Cosmop.
Paspalum scrobiculatum L.	G.	Nar.	Tr. old world
Setaria scandens Schrad.	G.		Braz.
Sorghum vulgare Pres.	G. C.	Hyd.	Tr. Reg.
Spartium junceum	L.	Em.-Cath.	Cosmop.
Stipa capillata L.	G.		S. Am. As.
Stipa inebrians Hance.	G.	Del.	China.
Stipa palmata Pall.			
Stipa pennata Hohen.	G.	Mech.	Eur. As. N.Am.
Stipa robusta Nash.	Ches.	Meb.	N. Am. Ry.Mts.
Triodia irritans Brown	G.	Mech.	Austr.
Zea Mays L.	G. C. L.	Hyd.	Paraguay

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* A case of poisoning by Agrostis alba was reported from West Liberty, Ia., by Dr. Hell. Probably forage poisoning.

GUTTIFERAE

NAME OF PLANT	Authority	Properties	Locality
Calophyllum Calaba Jacq.	G.	Sap.	Caith. Is.
Calophyllum Inophyllum L.	G.	F. P. Sap.	Tr. old world
Calophyllum montanum Vieill.	G.		N. Caled.
Clusia macrocarpa Spreng.	G.		Guiana
Garcinia Cambogia Desr.	Sm.		Ind.
Garcinia Forsteriana Bl.	G.		
Mammea americana L.	G. L.	Ant.	Tr. Am.
Stalagmitis Mangle	G.		

HAEMODORACEAE

Aletris farinosa L.	G.		N. Am.
Gyrotheca majalis Morong.	Ches.		E. N. Am.
Haemodorum sp.	G.		Austr. Braz.
Ophiopogon sp.	G.		Japan, Ind.
Sansevieria thyrsiflora Thumb.	G.		S. Afr.

HIPPOCASTANACEAE

Aesculus californica Nutt.	Ches.	Sap.	W.N.Am. Calif.
Aesculus flava Ait.	G. R.	Sap. F. P.	N. Am.
Aesculus glabra	Sm. Ches.	Sap.	N. Am.
Aesculus Hippocastanum L.	G. Ches. L.	Sap.	Turkey
Aesculus Pavia L.	G. R. Ches. L.	Sap. F. P.	N. Am.

HYDROPHYLLACEAE

Eriodictyon glutinosum Benth.	G. L.	Exp.	Calif.

HYPERICINEAE

Hypericum crispum L.	G.		Med. Reg.
Hypericum humifusum L.	G.		Eur. As.
Hypericum maculatum Walt.	Ches.	Acr.	E. N. Am.
Hypericum perforatum L.	Ches.	Acr.	Eur. N. Am.

ILICINEAE

Ilex Aquifolium L.	G. L.	Em. Cath.	Eur. As.

ILLECEBRACEAE

Paronychia bonariensis DC.	G.		Argent. Reg.
Paronychia capitata Lam.	G.	Sap.	Eur. Orient.

IRIDEAE

Belamcandra punctata Moench.	G.		China.
Crocus sativus L.	Sm. L.	Ir.	As. Min.
Gladiolus communis L.	C.	Ir.	Eur. Orient.
Gladiolus segetum	C.	Ir.	Med. Reg.
Homeria collina Vent.	G. M.		S. Afr.
Iris	G.	Ir.	N. Am.
Iris florentina Sair.	Sm. C. L.	Ir.	S. Eur.
Iris foetidissima L.	Sm. C.	Ir.	Eur. Orient.
Iris germanica L.	C. L.	Ir.	Eur. Orient.
Iris hybrida Retz.		Ir.	
Iris neglecta Parl.	Sm.	Ir.	

NAME OF PLANT	Authority	Properties	Locality
Iris prismatica Pursh.	L.	Ir.	N. A.
Iris Pseudoacorus L.	C. Sm.	Ir.	Eur. As. Ori.
Iris reticulata Bieh.	Sm.	Ir.	As. Minor
Iris sibirica L.	C.	Ir.	Eur. N. As.
Iris variegata L .	Wh.	Ir.	Eur. Orient.
Iris versicolor	L. Rusby	Ir.Em.Cath.	N. Am.
Sisyrinchium angustifolium Mill.	L.	Cath.	N. A.

JUGLANDACEAE

Juglans cinerea L.	L.	Cath.	N. A.
Juglans regia L.	C. L.	Ant. Astr.	Him. Reg.

LABIATAE

Achryospermum Gl.	G.	Urt.	Mad.
Eremostachys superba Royle.	G. R.	F. P.	Him. Reg.
Lagochilus inebrians Bunge.	G.	Nar.	As.
Leonurus Cardiaca L.	G. L.	Card.	N. Tem. Reg.
Ocymum viride Willd.	Sm.		Trop. Afr.
Salvia amarissima Orteg.	G.	Nar.	Mex.
Salvia officinalis L.	L.	Nar.	Med. Reg.
Salvia pratensis L.	G. L.	Nar.	Eur. Caucas.
Scutellaria galericulata L.	G.	Sed.	N. Tem. Reg.
Scutellaria lateriflora L.	L.	Sed.	N. A.
Stachys arvensis L.	G. M. L.	Antisp.	N.Tem. old wld.
Stachys palustris L.	L.	Antisp.	Eur. As. N. A.
Tetradenia fruticosa Benth.	G.	Pur.	Madag.
Teucrium Chamaedrys L.	L.		Eur.
Teucrium Marum L.	G. C. L.	Diaph.	Med. Reg.
Teucrium scordium	C. L.	Ant.	Eur.

LAURACEAE

Hernandia sonora L.	G.	P.	Ind.
Laurus nobilis L.	Sm. L.		Med. Reg.
Lindera Benzoin Muss.	Sm. L.	Ant.	E. N. Am.
Umbellularia californica Nutt.	G. C. L.	Hyd.	N. Am.

LEGUMINOSAE

Abrus precatorius L.	M. Sm. L.	Toxal. Ira.	India
Abrus pulchellus Wall.	Mi.		Ind. Afr.
Acacia sp.	G. C.	F. P.	Austr. Tr. Reg.
Acacia arabica Willd.	G. L.		Afr. As.
Acacia catechu Willd.	L.	Astr.	Ind. Ceylon
Acacia concinna DC.	G.	Astr.	Chili
Acacia Cunninghamii Hook.	G.	Sap.	Austr.
Acacia delibrata A.	G.	Sap.	Austr.
Acacia falcata Willd.	G.		Austr.
Acacia Georginae Bailey	G.		
Acacia Jurema Mart.	L.	Astr.	Brazil
Acacia pennata Willd.	G.		As. Afr.
Acacia penninervis Sieber.	G.		Austr.
Acacia pruinescens Kurz.	G.	F. P.	Burm.
Acacia pulchella R. Br.	G.		Austr.
Acacia salicina Linal.	G.		Austr.
Acacia verniciflua A. Cunn.	G. M.		Austr.
Acacia verticillata Willd.	G.	Sap.	Austr.
Adenanthera pavonina L.	G.		Tr. As. Malay

NAME OF PLANT	Authority	Properties	Locality
Albizzia anthelmintica Brongn.	G. L.	Sap. F. P.	Abyss.
Albizzia Lebbek Benth.	G.		Tr. old world
Albizzia odoratissima Benth.			Tr. As. Ind.
Albizzia procera Benth.	G.		Tr. As. Austr.
Albizzia stipulata Boiv.	G. R. E.	F. P.	Ind.
Anagyris foetida	C. G.		Sm. Cyt.
Andira anthelmintica Benth.	G.	Ant.	Braz.
Andira araroba Aguiar.	L.	Ir.	Braz.
Andira Aubletia Benth.	L.	Ant.	Guiana
Andira inermis H. B. K.	L.	Ir.	W. Ind. Braz.
Andira rosea Mart.	G.	F. P.	Braz.
Andira retusa HBK.	G. L.	Ant.	Guiana
Andira spinulosa Mart. & Benth.	L.	Ant.	Braz.
Andira vermifuga Mart. & Benth.	Mills.	Ant.	Braz.
Argyrolobium pumilum Eckl. & Zeyh.	G.		Afr. Austr.
Astragalus baeticus L.	G. L.	Sap.	Sic.
Astragalus Bigelovii A. Gray.	Ches.	Loco	W. N. Am.
Astragalus exscapus L.	L.	Diur.	Eur.
Astragalus galegiformis L.	G.	Sap.	Caucas. Reg.
Astragalus garbancillo Cav.	G.		Peru
Astragalus glycyphyllos L.	G. L.	Diur.	Siber. Eur. Caucas. Reg.
Astragalus hamosus L.	G.		Caucas. Reg. Med. Reg. Ind.
Astragalus Hornii A. Gray.	G. Ches.	Del. Loco.	N. Am.
Astragalus lentiginosus Dougl.	G. L.	Del. Loco.	N. Am.
Astragalus maximus Willd.	G.	Sap.	Armen. Caucas. Reg.
Astragalus mollissimus Torr.	G. L. Ches.	Del. Loco.	N.Am. Ry. Mts. Col.
Astragalus Mortoni Nutt.	G. L.	Del. Loco.	N. Am.
Astragalus ochroleucus Cass.	G.	Del.	Morocco
Astragalus oocarpus A. Gray.	L.	Del. Loco.	W. N. Am.
Astragalus Pattersoni A. Gray.	Ches.	Del. Loco.	W. N. Am.
Baptisia sp.	G.	Cyt.	N. Am.
Baptisia tinctoria R. Br.	L.	Em. Cath.	N. A.
Barbieria maynensis Poepp.	G.		Peruv.
Barbieria polyphylla DC.	G.		Porto Rico
Bauhinia coccinea DC.	G.		Cochin China
Bauhinia guianensis Aubl.	G.	F. P.	Guiana.
Bauhinia variegata L.	G. L.	Ant.	China, Burma. Ind.
Bowdichia virgilioides H. B. K.	R. L.	F. P.	S. A.
Brachysema undulatum Ker. Gawl.	M.		Austr.
Caesalpinia Bonducella Fleming.	G.		Tr. Cosmop.
Caesalpinia coriaria Willd.	L.	Astr.	N. A.
Caesalpinia pulcherrima Sw.	G.		Tr. Cosmop.
Calliandra Houstoni Benth.	G.	Sap.	Mex.
Camptosema pinnatum Benth.	G.		Braz.
Canavalia obtusifolia DC.	G.		Cos. Trop.
Cassia acutifolia Delil.	G. L.	Pur.	Egypt
Cassia alata L.	G.	F. P.	Cos. Trop.
Cassia angustifolia Vahl.	L.	Pur.	Trop. Afr.
Cassia didymobotrya Fres.	G.		Tr. Am. Abyss.
Cassia hirsuta L. f.	G. R.	F. P.	Tr. Am.
Cassia kituiensis Vatke.	G.	F. P.	Tr. Afr.
Cassia laevigata Willd.	G. M.		Cos. Trop.
Cassia marylandica L.	G. L.	Sap.	Tr. m.
Cassia occidentalis L.	Sm. L.	Pur.	Cosm. Trop.

NAME OF PLANT	Authority	Properties	Locality
Cassia sophora L.	G. M.		Tr. old world
Cassia stipulacea Ait.	G.		Chili
Cassia Sturtii R. Br.	G. M.		Austr.
Castanospermum australe A. Cunn.	G. M.	Sap. Ir.	Austr.
Centrosema amazonicum Mart.	G. R.	F. P.	Brazil
Centrosema Plumieri Benth.	G. R.	F. P.	S. Am.
Cercis canadensis L.	G.	Sap.	N. Am.
Cercis chinensis Bunge.	G.	Sap.	China
Cladrastis amurensis Benth.	G.		Amur. Reg.
Clitoria amazonum	R.	F. P.	S. Am.
Clitoria arborescens Ait.	G. R.	F. P.	Trinidad Is.
Clitoria Ternatea L.	L.	Em.	Trop. Reg.
Copaifera Langsdorffii Desf.	L.	Diur.	Braz.
Copaifera Salikorinda Heck.	G.	Cou.	S. Am.
Coronilla Emerus L.	G. C.		S. Eur.
Coronilla juncea L.	G.		Eur.
Coronilla montana Scop.	G.		
Coronilla scorpioides Koch.	G. C. L.	Card.	Per. Reg. Med.
Coronilla varia L.	G. C.		Eur.
Crotalaria alata Hamill.	G. M.		Tr. As.
Crotalaria Mitchelii Benth.	M. G.		Austr.
Crotalaria paniculata Willd.	G.		Tr. As.
Crotalaria sagittalis L.	Ches. L.	Ineb.	N. Am.
Crotalaria striata Schrank.	G.		Braz.
Crotalaria verrucosa L.			Cosm. Trop.
Cytisus Alschingeri Vis.	C.		Dalmatia.
Cytisus austriacus L.	C.		Cauc.
Cytisus biflorus Ker. Gawl.	C.		S. Eur.
Cytisus capitatus Scop.	C.		S. Eur.
Cytisus hirsutus L.	C.		As. Min.
Cytisus nigricans L.	C.		Eur. As.
Cytisus proliferus L.	C.		Teneriffe
Cytisus purpureus Scop.	C.		Eur. As.
Cytisus scoparius Link.	G. C. L.	Diur.	Eur. Jap.N.Am.
Cytisus sessilifolius L.	C.		S. Eur.
Cytisus supinus L.	C.		Eur.
Dalbergia lanceolaria L. f.	G.		Ind.
Dalbergia toxicaria Baill.	G.		Madag.
Derris amoena Benth.	G.		Burm. Malaya
Derris elliptica Benth.	G. L.	F. P. Ins.	Burm. Malaya
Derris guianensis Benth.	G. R.	F. P.	Guiana. Braz.
Derris Negrensis Benth.	G.	F. P.	Braz.
Derris uliginosa Benth.	E.&G. R. L.	F. P.	Tr. old world
Detarium Senegalense J. F. Gmel.	G.		Tr. Afr.
Entada polystachya DC.	G.		Tr. Am.
Entada scandens Benth.	G. L.	Sap.	Tr. Am.
Enterolobium cyclocarpum Griseb.	G.	Sap.	Jamaica
Enterolobium timboiiva Mart.	G.	Sap.	Braz.
Eperua falcata Aubl.	G.	Em.	Guiana
Erythrina Corallodendron L.	G. L.	Diur.	E. Ind. N. Am.
Erythrina Hypahphones Boerl.	G.		
Erythrina Mulungu Mart.	L.	Hpy.	Braz.
Erythrophleum Comminga Baill.	C.		Mad.
Erythrophleum guineense G. Don.	C. L.	A. P. Nar.	Trop. Afr.
Euchresta Horsfieldii Bena.			Jav.
Flemingia congesta Roxb.		Taen.	Tr. As.
Galega officinalis L.	G. L.	Sap.	Eur. As.
Galega orientalis Lam.	G.	Sap.	Caucas. Reg.
Gastrolobium bilobum R. Br.	G. M. Sm.	Ineb.	Austr.

NAME OF PLANT	Authority	Properties	Locality
Gastrolobium calycinum Benth.	G. M. Sm.	Ineb.	Austr.
Gastrolobium Callistachys Meiss.	G. M. Sm.	Ineb.	Austr.
Gastrolobium grandiflorum F. M.	G.	Ineb.	Austr.
Gastrolobium obovatum Benth.	G. M. Sm.	Ineb.	Austr.
Gastrolobium ovalifolium Henfr.	G.	Ineb.	Austr.
Gastrolobium oxylobioides Benth.	G. M. Sm.	Ineb.	Austr.
Gastrolobium spinosum Benth.	G. M. Sm.	Ineb.	Austr.
Gastrolobium trilobum Benth.	G. M. Sm.	Ineb.	Austr.
Genista monosperma Lam.	G.	Ineb.	Med. Reg.
Genista sphaerocarpa Lam.	G.	Ineb.	Med. Reg.
Genista tinctoria L	L.	Sur.	Eur. Cau. Reg.
Geoffraea superba	G.	Ant.	S. Am.
Gleditschia amorphoides Griseb.	G.	Mech.	N. Am.
Gleditschia sinensis Lam.	G.	Sap.	China
Gleditschia triacanthos L.	G.	Mech.	N. Am.
Gliricidia maculata HBK.	G.		Guat.
Glycine hispida Max.	G.	Em.	Japan
Gompholobium uncinatum A. Cunn.	G. M.	Ineb.	Austr.
Goodia lotifolia Salisb.	G.	Ineb.	Austr.
Gymnocladus canadensis	G. C.	Sap.	N. Am.
Gymnocladus chinensis Buill.	G.	Sap.	China
Halimodendron argenteum Fisch.	G.	Sap.	Reg. Caus. Per. N. As.
Hosackia Purshiana Benth.	G.		N. Am.
Hymenaea Courbaril L.	G.	Ant.	S. Am.
Indigofera anil L.	G.		S. Am.
Indigofera australis Willd.	G. M.		Austr.
Indigofera galegoides DC.	G.	Hyd.	Malay
Indigofera tinctoria L.	G.	Ins.	Trop. Reg.
Isotropis juncea Turcz.	M.		Austr.
Laburnum anagyroides Medic.	C. Sm. L.	Depr. Cyt.	Eur.
Lathyrus amoenus Fenzl.	C.		Syria
Lathyrus Aphaca L.	C.	Ast. Hyd.	Eur. Orient.
Lathyrus Cicera L.	C.		Eur. Orient.
Lathyrus Clymenum L.	C.		Med. Reg.
Lathyrus odoratus L.	C.		Italy
Lathyrus purpureus Presl.	C.		Sic.
Lathyrus sativus L.	F. Sm. C.	Ent.	Eur. N. Afr. Orient.
Lessertia annularis Burch.	M.		Austr.
Leucaena glauca Benth.	G.		Trop.
Lonchocarpus densiflorus Benth.	E. G. R.	F. P.	Guiana
Lonchocarpus ichthyoctonus Baill.	G.		Madag.
Lonchocarpus latifolius Kth.	G. R.	F. P.	Tr. Am.
Lonchocarpus Nicou DC.	G. R. E.	F. P.	Tr. Afr.
Lonchocarpus rariflorus Hart.	R.		Braz.
Lonchocarpus violaceus Kunth.	G.	F. P.	Tr. Afr.
Lotus australis Andr.	G. Sm. M.		Austr.
Lotus corniculatus L.	M.		Tem. old world Austr.
Lupinus sp.	G.		N. Temp. Reg.
Lupinus albus L.	C. Ches.		S. Eur.
Lupinus angustifolius L.	C.		Med. Reg.
Lupinus densiflorus Benth.	Sm.		Cal.
Lupinus leucophyllus Dougl.	Ches.		W. N. Am.
Lupinus luteus L.	C.		Med. Reg.
Melilotus alba Lam.	L.	Con.	
Melilotus indica Desf.		Con.	Eur. As.
Melilotus officinalis Desr.	L.	Con.	Eur. N. As.

NAME OF PLANT	Authority	Properties	Locality
Milletia caffra Meiss.	G.		S. Afr.
Milletia ferruginea Hochst.	R.	F. P.	S. Afr.
Milletia pachycarpa Benth.	G.		Malay
Milletia rostrata Meig.	G.		Java
Milletia sericea G. & E.	R. E.	F. P.	Burm. Malay
Milletia splendens Wright & Arn.	G.		Ind.
Mucuna capitata Max.	G.	F. P.	Him.Reg.Malay
Mucuna gigantea DC.	G.		Tr. Afr.
Mucuna purpureus DC.	Whi.	Ir.	Trop.
Mucuna urens DC.	L.	Ir.	S. Am.
Mucuna venenosa A. Murr.	G.		Tr. Afr.
Muellera moniliformis L.	G. E. R.	F. P.	Trop. Afr.
Muellera Telfairii Baker	G.		Mad.
Myroxylon Pereirae Klotzsch.	L.	Stim.	C. A.
Myroxylon peruiferum L.	L.	Stim.	Eq. Peru. Braz.
Myroxylon toluiferum HBK.	L.	Cou.	Trop. Am.
Nissolia fruticosa Jacq.	G.	F. P.	Tr. Am.
Ormocarpum glabrum Teis. & Binn.	G.		Celebes.
Ormosia coccinea Jacks.	G.		Tr. Am.
Ougeinia dalbergioides Benth.	G.		Ind.
Oxylobium parviflorum Benth.	G. M.		Austr.
Oxytropis foetida DC.	Sm.		Eur.
Oxytropis Lambertii Pursh.	Ches.	Loco	W. N. Am. Ia. Ry Mts.
Oxytropis Lapponica Gaud.	G.	Hyd. Sap.	Eur. N. As.
Oxytropis sulphurea Fisch.	G.	Hyd.	Siber.
Pachyrhizus angulatus Rich.	G.		Tr. As.
Pachyrhizus tuberosa Spreng.	G.	F. P.	Ind.
Parkia africana R. Br.	G.		Tr. Afr.
Pentaclethra macrophylla Benth.	G.	Alk.	Tr. Afr.
Phaseolus aconitifolius Jacq.	G.	Hyd. Ast.	Ind. Ar.
Phaseolus lunatus L.	Sm.		S. Am. Cosm. Cult.
Phaseolus multiflorus Willd.	G.		Mex.
Phaseolus semierectus L.	G. R.	F. P.	Trop. Reg.
Phaseolus vulgaris L.	G. C.		N. Am. Cosm. Cult.
Physostigma venenosum Balf.	G. Sm. L.	Dep. Eser.	Afr.
Piptademia peregrina Benth.			Braz.
Piscidia Erythrina L. E.	G.Sm.R.L.	Ineb. F. P.	Trop. Am.
Pithecolobium bigeminum Mart.	G.		Malay
Pithecolobium fasiculatum Benth.	G.	F. P.	Malay
Pithecolobium Minahassae Teis. & Binn.	G.		Malay
Pithecolobium montanum Benth.	G.		Him.Reg.Malay
Pithecolobium Saman Benth.	G.	Sap.	Tr. Am.
Pongamia Piscida Steud.	G. E.	F. P.	Ind.
Prosopis juliflora Benth.	G.		N. Am. Tex.
Prosopis ruscifolia Griseb.	G.	Sap.	Argen.
Psoralea glandulosa L.	G. L.	Em.	Chili. Mex.
Psoralea macrostachya DC.	G.	Sap.	Cal.
Psoralea pentaphylla L.	G.		Mex.
Psoralea tenuiflora Pursh.	G.	Sap.	N. Am.
Pterocarpus esculentus Schw.	G.	Intox.	Tr. Afr.
Pterocarpus Marsupium Roxb.	L.	Astr.	Ind.
Rhynchosia minima DC.	G.		Cosmop. Trop.
Robinia Pseudo-acacia L.	G. Ches. L. Rusby	Toxal.	N. Am. S. States N. A.
Robinia viscosa Vent.	Rusby	Em.	S. Eur.

NAME OF PLANT	Authority	Properties	Locality
Sabinea florida DC.	G.		S. Eur.
Securigera Coronilla DC.	G.		N. Am. S.
Sesbania vesicaria Ell.	Ches.		States
Sophora alopecuroides L.	G.		Him. Reg.
Sophora japonica L.	L.	Pur.	Japan, China
Sophora mollis Grah.	G.		China, Him. Reg.
Sophora secundiflora Lah.	G. Ches. L.	Nar.	Mex.
Sophora sericea Nutt.	L. Ches.	Nar.	N. A.
Sophora tomentosa L.	G. M.	Sop.	Cold Reg.
Stryphnodendron Barbatimam Mart.	G.	Sap.	Braz.
Stryphnodendron polyphyllum Mart.	L.	Astr.	Braz.
Swainsona coronillaefolia Salisb.	G.	Ineb.	Austr.
Swainsona Greyana Lindl.	G. M.	Ineb.	Austr.
Swainsona Oliverii F. Muell.	M.	Ineb.	Austr.
Swainsona phacoides Benthm.	M.	Ineb.	Austr.
Swainsona procumbens F. Muell.	M.		Austr.
Swartzia triphylla Willd.	G.		Tr. Am.
Templetonia egena Benth.	G. M.		Austr.
Templetonia purpurea	M.		Austr.
Templetonia retusa R. Br.	G.		Austr.
Tephrosia astragaloides Benth.	G.		Austr.
Tephrosia candida DC.	G. R.	F. P.	Tr. As.
Tephrosia cinerea Pers.	G. R.	F. P.	
Tephrosia coronillaefolia DC.	G. R.	F. P.	Borbon. Is.
Tephrosia densiflora	G.	F. P.	Tr. Afr.
Tephrosia frutescens DC.	Sm.		Honduras.
Tephrosia macropoda Harv.	G.	F. P.	S. Afr.
Tephrosia nitens Benth.	G.		Tr. Am.
Tephrosia periculosa Baker.	G.	F. P.	
Tephrosia purpurea Pers.	G. M. R. L.	F. P.	Austr.
Tephrosia tomentosa Pers.	R.	F. P.	Arab.
Tephrosia toxicaria Pers.	G. R. L. E.		Jamaica
Tephrosia virginiana Pers.	G.	A. P.	N. Am.
Tephrosia Vogelii Hook.	G. R.		Tr. Afr.
Teramus labialis Spreng.	G.	Sap.	Cosm. Trop.
Tetlapleura caerulea Willd.	G.		Tr. Afr.
Tetrapleura Thonningii Benth.	Ches.	Diur.	W. N. Am.
Thermopsis rhombifolia Rich.	L.	Tymp.	Egypt
Trifolium elegans Sair.	C.	Tymp.	Med. Reg.
Trifolium hybridum L.	C.		S. Eur. As. Min.
Trifolium incarnatum L.	G.	Mec.	S. Eur.
Trifolium nigrescens Viv.	C.		S. Eur.
Trifolium repens L.	C.	Tymp.	N. Temp. Reg.
Trigonella cretica Boiss.	G.		As. Min.
Vicia Ervilia Willd.	C.		Eur. N. Afr.
Wistaria chinensis DC.	G.		China
Xylia dolabriformis Benth.	G.	Sap.	Burma. Malay
LENTIBULARIACEAE			
Pinguicula vulgaris L.	G.		Eur. Sber. N. Am.
LILIACEAE			
Agrostocrinum stypandroides Ev. M.	G. M.		Austr.
Allium ascalonicum L.	L.	Ant.	Cult.
Allium canadense L.	L.	Ant.	N. A.
Allium Cepa L.	L.	Ent.	Per. Bel.
Allium Douglasii Hook.	L.	Ant.	Calif.

NAME OF PLANT	Authority	Properties	Locality
Allium Macleanii Baker	L.	Ant.	Afghan.
Allium Moly L.	L.	Ant.	Eur.
Allium Porrum L.	L.	Ant.	Eur.
Allium sativum L.	L.	Ir.	Eur. N. A.
Allium Schoenoprasum L.	L.	Ant.	Eur. As.
Allium tricoccum Soland.	Wh. L.	Ir.	N. A.
Allium ursinum L.	C. L.	Ant.	Eur. N. As.
Allium Victorialis L.	G. L.	Ant.	Eur. Sib.
Allium vineale L.	C.	Ir.	Eur. N. A.
Aloe abyssinica Lam.	L.	Pur.	Austr.
Aloe africana Mill.	L.	Pur.	S. Af.
Aloe arborescens Mill.	L.	Pur.	S. Af.
Aloe chinensis Steud.	L.	Pur.	China
Aloe ferox. Mill.	G. L.	Pur.	S. Afr.
Aloe saponaria Haw.	G.	Pur.	S. Afr.
Aloe spicata L.	L.	Pur.	S. Afr.
Aloe succotrina Lam.	L.	Pur.	S. Afr.
Aloe tenuior Haw.	G.	Pur.	Med. Reg.
Aloe vera L.	G.	Pur.	Med. Reg.
Anemarrhena asphodeloides Bunge.	G.		China.
Asparagus officinalis L.	L.	Ir.	Eur. As. N. A.
Asparagus scaber Brign.	L.	Ir.	Med. Reg. Cauc.
Astelia Banksii A. Cunn.	G.		N. Z.
Bulbine bulbosa Haw.	G. M.		Austr.
Bulbine semibarbata Haw.	G.		Austr.
Chamaelirium carolinianum Willd.	G. L.	Ant.	E. N. A.
Colchicum autumnale L.	G.C.Sm.L.		Eur.
Colchicum neapolitanum Tenore.	C.	Ast.	Italy.
Colchicum speciosum Stw.	Sm.	Ast.	Cauc. Reg.
Colchicum variegatum L.	C.	Ast.	S. Eur.
Convallaria majalis L.	G.Sm.C.L. Ches.Rusby	Car.	N. Tem. Reg.
Dianella nemorosa Lam.	G.		As. Trop. Austr.
Dracaena arborea Hort.	G.		Tr. Afr.
Drimia ciliaris Jacq.	G.	Em.	Agr. Austr.
Drimia Cowanii Ridl.	G.		Madag.
Erythronium albidum Nutt.	L.	Em.	N. A.
Erythronium americanum Ker. Gawl.	L.	Em.	N. A.
Erythronium Dens-canis L.	G.	Em. Ant.	Eur. N. As.
Erythronium grandiflorum Pursh.	G.		N. Am.
Erythronium purpurascens S. Wat.	G.	Sap.	Cal.
Fritillaria Imperialis L.	G. C. Mi.	Ir.	Persia. Him. Reg.
Fritillaria Meleagris L.		Ir.	Eur. Cauc.
Fritillaria pudica Spreng.	L.	Ineb.	Reg.
Gloriosa simplex L.	G.	Nar.	W. N. Am.
Gloriosa superba L.	G.	Em.	Tr. Afr.
Helonias frigida Lindl.	G.		Trop. As.
Hyacinthus orientalis L.	G.		
Leucocoryne	M.		Austr.
Leucocrinum montanum Nutt.	Ches.		N. Am. Ry. Mts.
Medeola virginica L.	G.	Sap.	N. Am.
Melanthium cochinchinense Lour.	G.		Cochin China.
Melanthium virginicum L.	G. L.	Fly Poison	N. Am.
Muscaria comosum Mill.	G.	Sap.	Med. Reg. Ori.

NAME OF PLANT	Authority	Properties	Locality
Muscaria racemosum Willd.	Sm.	Ir.	Med. Reg. Cauc.
Narthecium ossifragum Huds.	G. C.		Eur. As. Min. N. Am.
Nothoscordum striatum Kunth.	Ches.		N. Am. S. States
Ornithogalum sp.	Mi.		Eur. As. Afr.
Ornithogalum nutans L.	G.	Em.	Eur. As. Min.
Ornithogalum thyrsoides Jacq.			S. Afr.
Ornithogalum umbellatum L.			N. Afr. As. Min.
Paradisea Liliastrum Bertol.	G.	Card.	Eur.
Paris obovata Ledeb.	G.		Siber.
Paris quadrifolia L.	G. C. Mi. Sm. L.	Ir. Nar.	Eur. N. As.
Polianthes tuberosa L.	G.		Mex.
Polygonatum biflorum Ell.	G.		N. Am.
Polygonatum officinale All.	G.		Eur. Siber.
Polygonatum verticillatum All.	G.		Eur. N. As.
Ruscus aculeatus L.	G. L.	Sap.	Eur. Ori.
Schoenocaulon officinale A. Gr.	G. Sm. L.	Ast. Par.	Mex.
Scilla bifolia L.	Sm.	Ir.	Eur. As. Min.
Scilla festalis Salisb.	Sm.	Ir.	Eur.
Smilax pseudo-syphilitica Kunth.	G.	Sap.	Braz.
Stypandra glauca R. Br.	G. M.		Austr.
Tofieldia calyculata Wahl.	G.	Ant.	Eur. N. Am.
Trillium erectum L.	L. Rusby	Em.	E. N. Am.
Trillium grandiflorum Salisb.	G.	Sap.	N. Am.
Tulipa Gesneriana L.	G.		Eur. Orient
Tulipa sylvestris L.	G.		Eur.
Urginea Scilla Steinh.	G. C. Sm. R. L.	Ast. F. P.	S. Afr.
Veratrum sp.			N. Temp. Reg.
Veratrum album L. E.	G. Mi. C. Sm. L. E.	Ast. F. P.	N. As.
Veratrum californicum Dur.	Ches. L.	Ir.	W. N. Am. Ry. Mts.
Veratrum viride Ait.	G. Ches. L. Rusby	Ir. Em.	E. N. Am.
Xanthorrhoea sp.	G.		Austr.
Xerophylla Douglasii S. Wat.		Sap.	E. N. Am. S. States.
Xerophylla setifolium Michx.	G.		E. N. Am.
Yucca filamentosa L.	G.	Sap.	W. N. Am. Ry. Mts.
Yucca glauca (Nutt.) Carr.	G.	Sap.	E. N. Am. S. States.
Zygadenus angustifolium S. Wats.	L.		N. A.
Zygadenus elegans Pursh.	Ches. L.		E. N. Am. Ry. Mts.
Zygadenus venenosus S. Wat.	Ches. G. L.		N. W. Am.

LINACEAE

Hugonia Mystax L.	G.		Ind.
Linum catharticum L.	G. L.	Pur.	Eur. Orient.
Linum rigidum Pursh.	Ches.	Pur.	N. Am. N. M. Tex.

NAME OF PLANT	Authority	Properties	Locality
Linum toxicum Boiss.	G.		Syria.
Linum usitatissimum L.	G. L.	Ir.	Eur. Orient. N. Am.

LOGANIACEAE

NAME OF PLANT	Authority	Properties	Locality
Anthocleista grandiflora Gilg.		Alk.	
Buddleia brasiliensis Jacq.	G.	F. P.	Hab.?
Buddleia curviflora Hook. & Arn.	G.		Chili. Peru.
Buddleia globosa Hope.	G.	Sap.	China.
Buddleia Lindleyana Fort.	G.	F. P.	Madag.
Buddleia madagascariensis Lam.	G.	Taen.	Abyss.
Buddleia polystachya Friesen.	R. G.	Sap. F. P.	Brazil.
Buddleia variabilis Hemsl.		Sap.	
Buddleia verticillata HBK.		F. P.	Mex.
Fagraea ceilanica Thumb.	Sm. G.	Cou.	Zeyl.
Gelsemium sempervirens Ait.	G.C.Sm.L.	Ast.	E. N. Am. S. Sts.
Nicodemia diversifolia Ten.	G.	Sap.	Mascar. Is.
Spigelia Anthelmia L.	G. L.	Ir. Nar.	Trop. Am.
Spigelia glabrata Mart.	G.		Brazil.
Spigelia marylandica L.	G. Sm. L.	Ir. Nar.	E. N. Am.
Spigelia pedunculata HBK.	G.		N. Old World.
Strychnos angustifolia Benth.	G.		China.
Strychnos brachiata Ruiz. & Pav.	G.	Con.	Peru.
Strychnos Castelnaei Wedd.	G. Sm. L.	Con.	India.
Strychnos colubrina L.	L.	A. P.	Guiana
Strychnos cogens Benth.	L.	A. P.	Braz.
Strychnos Crevauxiana Baill.	G. L.	A. P.	Guiana.
Strychnos gubleri Planch.	L.	A. P.	Venez.
Strychnos Icaja Baill.	G. L.	Ordeal Poi.	Trop. Afr.
Strychnos Ignatii Berg.	G. Sm. L.	Con.	Philipp. Is.
Strychnos innocua Del.	G.		Nubia.
Strychnos malaccensis Benth.	L.		Bur. Malay.
Strychnos Melinoniana Baill.	G.		Guiana.
Strychnos Nux-Vomica L.	G.Sm.R.L.	Con. F. P.	Burma.
Strychnos paniculata Champ.	G.		China.
Strychnos potatorum L.	G.		Burma.
Strychnos Pseudo-quina A. St. Hil.	G.		Braz.
Strychnos Santhierana Pierre.	G.		
Strychnos spinosa Lam.	G.		Madag.
Strychnos Tieute Lesch.	G. Sm. L.	Con. A. P.	Java.
Strychnos toxifera Schomb.	G. Sm.	Con. A. P.	Guian.
Strychnos yapurensis Planch.	L.	A. P.	Ecuador.

LORANTHACEAE

NAME OF PLANT	Authority	Properties	Locality
Phoradendron flavesceus Nutt.	L. Hyams.		N. Am. S. Sts.
Viscum album L.	Sm. L.	Ir.	Eur. Temp. As.

LYCOPODIACEAE

NAME OF PLANT	Authority	Properties	Locality
Lycopodium clavatum L.	Mi. L.	Diur.	N. Am. Eur.
Lycopodium Selago	Mi. L.	Pur.	Eur.

LYTHRACEAE

NAME OF PLANT	Authority	Properties	Locality
Ammannia baccifera L.	G.	Acr.	Tr. Old World
Cuphea viscossissima Jacq.	G.	Card.	N. Am. S. Sts.
Ginora mexicana Lam.	G.	Em.	Mex.

NAME OF PLANT	Authority	Properties	Locality
Lagerstroemia Flos-reginae Retz.	G.	Nar.	Trop. As.
Nesaea verticillata HBK.	G.		N. A. S. Am.
Punica Granatum L.	G. L.	Taen.	S. Eur. Maurit.

MAGNOLIACEAE

Drimys aromatica F. Muell.	G.	Hyd.	Austr.
Drimys Winteri Forst.	G.	Hyd.	S. Am.
Illicium anisatum Gaertn.	G. Sm. L.		China.
Illicium floridanum Ellis.	G. Ches. L.		N. Am. S. Sts.
Liriodendron chinense Sarg.	G.		China.
Liriodendron tulipifera L.	G.	Hyd. Sap.	E. N. Am.
Magnolia grandiflora L.	G.		N. Am. S. Sts.
Manglietia glauca BL.	G.		Java.
Michelia Champaca L.	G.	Alk.	Malay.
Michelia fuscata Bl.	G.	Alk.	China.
Michelia parvifolia Bl.	G.	Alk.	Java.
Talauma macrocarpa Zucc.	G.		Mex.
Talauma ovata A. St. Hil.	G.		Braz.

MALPIGHIACEAE

Byrsonima amazonica Griseb.	G.		Braz.
Byrsonima crassifolia HBK.	G.		Guiana.
Byrsonima spicata Rich.	G.		Thop. Am.
Heteropteris syringaefolia Griseb.	G.		Braz.
Malpighia oxycocca Griseb.	G.		W. Ind.
Sphedamnocarpus angolensis Planch.	G.		Trop. Afr.

MALVACEAE

Althaea rosea L.	G.	Abort.	Ori. Cult. Eur. N. Am.
Gossypium herbaceum L.	G. L.	Abort.	Trop. As.
Hibiscus diversifolius Jacq.	G.	Abort.	Tr. Old World.
Pavonia zeylanica	G.	Ant.	
Sida jamaicensis L.	G.		Trop. Am.
Sida paniculata L.	G.	Mech.	Trop. Am.
Sida urens L.	G.	Ir.	Trop. Am. Afr.

MELASTOMACEAE

Mouriria rhizophoraefolia Gard.	G.		Martinq. Is.

MELIACEAE

Carpa moluccensis Lam.	G.		Tr. Old World.
Dysoxylum arborescens Miq.	G.		Borneo.
Flindersia Schottiana Fv. Muell.	G.		Austr.
Lansium domesticum Jack.	G.	Ant.	Malay.
Melia Azeldarach L.	G. C. Ches. L.	Ant.	Himal. Ch. Cult. S. States.
Melia birmanica Kurz.	G.		Burma.
Naregamia alata W. & A.	G. L.	Em.	Ind.
Ptaeroxylon obliquum Rdlk.	G.		Afr.
Sandoricum indicum Cav.	G.		Trop. As.
Swietinia humilis Zucc.	G.		Mex.
Swietinia Mahagoni Jacq.	L.	Astr.	S.A. Mex. W.I.
Trichilia sp.	G.	Sap.	S. Am.
Trichilia Moschata Sw.	L.	Astr.	Jamaica.
Trichilia trifolia L.	G.	Abort.	Venz.
Walsura piscidia Roxb. G. & E.	R. E.	F. P.	India.

MELIANTHACEAE

NAME OF PLANT	Authority	Properties	Locality
Bersama sp.	G.		Arab. & Abyss.
Melianthus comosus Vahl.	G.		S. Afr.
Melianthus major L.	G.		S. Afr.

MENISPERMACEAE

Anamirta paniculata Colebr.	G. Sm. C. R. L. E.	Del. F. P.	Ind.
Anomospermum japurense Eich.	G.		Braz.
Cissampelos Pareira L.	G.		Trop. Reg.
Cocculus Ferrandianus Gaudich.	G.	F. P.	Hawai. Is.
Cocculus glaucescens Bl.	G.	Sap.	Bur. Jav.
Cocculus laurifolius DC.	G.		Him. Reg. Jap.
Cocculus toxiferus Wedd.	G.		
Coscinium Blumeanum Miers.	G.	Sap.	Ind.
Menispermum canadense L.	L.	Diur.	N. A.
Pachygone ovata Miers.	G. R.	F. P.	Malay. Ind.
Pericampylus incarius Miers.			Ind. Malay.
Sarcopetalum Harveyanum Fv. M.	G.		Austr.
Stephania discolor Spreng.	G.		Tr. Old World.
Stephania aculeata Walp.	G.		
Tiliacora racemosa Colebr.	G.		Ind. Jav.

MONIMIACEAE

Kibara angustifolia	Sm.		

MONOTROPACEAE

Monotropa uniflora L.	G. L.	Androm.	E. N. Am. Jap. Him. Reg.
Pterospora andromedea Nutt.	G.		N. Am.

MORACEAE

Morus alba L.	L.	Taen.	Temp. As.
Morus nigra L.	L.	Taen.	Temp. As.
Morus rubra L.	L.	Taen.	N. A.

MYOPORACEAE

Eremophila maculata Fv. M.	M. G.		Austr.
Myoporum deserti A. Cunn.	G. M.		Austr.
Pholidia maculata Baill.	G.		

MYRICACEAE

Myrica cerifera	L.	Astr. Nar.	N. A.

MYRISTICACEAE

Myristica gibbosa Hook.	L.	Astr.	India.
Myristica philippensis Lam.	L.	Astr.	Phil. Is.

MYRSINACEAE

Aegiceras majus Gaertn.	G. E. R.	Sap.	Tr. Old World.
Aegiceras minus Gaertn.	G. R.	F. P.	India.
Anguillaria dioica R. Br.	M.		Aust.
Clavija macrocarpa Ruiz. & Pav.	G.		S. Am.

NAME OF PLANT	Authority	Properties	Locality
Embelia micrantha A. DC.	G.	Ant.	Maurit. Is.
Embelia Ribes Burm.	G.		Trop. As.
Jacquinia arborea Vahl.	G. R.	F. P.	Trop. Am.
Jacquinia armillaris Jacq.	G. E. R.	F. P.	W. Ind.
Jacquinia obovata Schrad.	G. R.	F. P.	
Maesa indica Wall.	G.	F. P.	Ind. Malay.
Maesa lanceolata Forsk.	G.		N. Afr.
Myrsine africana L.	G.	Taen.	Him. Reg. Tr. & S. Afr. Azores W. Ind.
Theophrasta americana L.	G.		

MYRTACEAE

Baeckea frutescens L.	G.	Abort.	Malay. China.
Barringtonia acutangulata Gaertn.	G.		Malacca Is.
Barringtonia alba Blume.	G.		Malacca Is.
Barringtonia Butonica Forst.	G. R.	F. P.	Pacific Is.
Barringtonia Careya Fv. M.	G.		Austr.
Barringtonia insignis Miq.	G.		Malay.
Barringtonia intermedia Viell.	G.	F. P.	N. Caled.
Barringtonia neo-caledonica Viell.			N. Caled.
Barringtonia racemosa Rexb.		F. P.	Malay. Polyn.
Eucalyptus Globulus Labill.	L.	Astr.	Austr.
Eucalyptus microtheca F.v. Muell.	G.	F. P.	Austr.
Eucalyptus rostrata Schlecht.	L.	Astr.	Austr.
Eugenia Jambos L.	G.		Trop. As.
Lecythis amara Aubl.	G.		Guian.
Lecythis lanceolata Poir.	G.	Nar.	Brazil.
Melaleuca leucodendron L.	Sm. L.		Austr.
Napoleona Whitfieldii Van Houtte	G.	Sap.	Trop. Afr.
Pimenta acris Kostel.	Whi.	Ir.	Ind.
Psidium montanum Sw.	G.		W. Ind.

MUSACEAE

Musa sapientum L.	G.	Sap.	Trop. Reg.
Nepenthes gracilis Korth.	G.		Borneo.

NYCTAGINACEAE

Boerhaavia erecta L.	G.	Em.	N. Am. W. Ind.
Boerhaavia hirsuta L.	G.	Em.	N. Am. W. Ind.
Boerhaavia repens L.	G.	Em.	Cosm. Trop.
Pisonia obtusata Jacq.	G.	Em.	W. Ind.
Pisonia tomentosa Casar.	G.	Em.	Braz.

NYMPHAEACEAE

Euryale ferox Salisb.	Sm.		Ind. China.
Nymphaea advena Ait.	L.	Astr.	N. A.
Nymphaea alba L.	G.		N. Temp. Reg.
Nymphaea lutea L.	L.	Astr.	Eur.

OCHNACEAE

Ochna sp. Schreb.	G.		Afr. Ind.

OLACEAE

Villaresia Moorei F. v. M.	G.		Austr.

OLEACEAE

NAME OF PLANT	Authority	Properties	Locality
Chionanthus picrophloia Fv. Muell.	G.		
Chionanthus virginica L.	G. Sm. L.	Nar.	N. Am.
Forsythia intermedia Zabel.	G.	Sap.	
Forsythia suspensa Vahl.	G.	Sap.	Japan, China.
Forsythia viridissima Lindl.	G.		China.
Jasminum floribundum R. Br.	G.		Abyss.
Jasminum officinale L.	Sm.	Ast.	
Jasminum Sambac Ait.	G.		Trop. As.
Ligustrum vulgare L.	Sm. Ches.	Ir.	Eur. As. N.Am.
Olea dioica Roxb.	G.	Em.	Ind.
Phillyrea media L.	G.	Sap.	Med. Reg.

ONAGRACEAE

Ludwigia erigata L.	G.		Ind.
Montinia caryophyllacea Thunb.			S. Afr.
Trapa natans L.	G.		Ori. Ind. Eur.

ORCHIDACEAE

Angraecum fragans Thou.	G. L.	Ant.	Mascar Is.
Catasetum sp.	G.		Ind.
Cymbidium aloifolium Sw.	G.	Em.	Ind.
Cypripedium pubescens Willd.	G.	Ir.	N. Am.
Cypripedium spectabile Salisb.	G.	Ir.	N. Am.
Dendrobium nobile Lindl.	G.		China.
Eria stellata Lindl.	G.		Philipp. Is.
Eulophia virens Spreng.	G.	Ant.	Ind.
Habenaria nigra R. Br.	G.		Eur.
Neottia Nidus-avis Rich.	G.	Ant.	Eur. N. As.
Orchis coriophora L.	G.	Cou.	Eur. Orient.
Orchis odoratissima L.	G.	Cou.	Eur.
Orchis purpurea Huds.	G.	Cou.	As. Min.
Orchis Simia Lam.	G.	Cou.	Eur. Ori.
Phajus callosus Lindl.	G.		
Phalaenopsis amabilis Blume.	G.		Malay.
Phalaenopsis Lueddemanniana Reichb.	G.		Philipp. Is.

OROBANCHACEAE

OXALIDACEAE

Oxalis Acetosella L.	L.	Ant.	Eur. As. N. Afr. N. A.
Oxalis amara A. St. Hill.	G.		Braz.
Oxalis Pes-caprae L.	G. L.	Diur.	S. Afr.
Oxalis purpurata Jacq.			S. Afr.
Oxalis Smithiana Eckl. & Zeyr.	G.		S. Afr.

PALMACEAE

Areca Catechu L. var. nigra.	G. L.	Nar.	Ind. Malay.
Arenga saccharifera Labill.	G.		Malay.
Borassus flabellifera Murr.	G.		Ind.
Cocos amara Jacq.	G.		W. Ind.
Cocos nucifera L.	L.	Ver.	
Corypha umbraculifera L.	G.		Trop. Afr. Ind.
Hyphaene thebaica Mart.	G.	Taen.	Trop. Afr.
Hyphorbe indica Gaertn.	G.		
Phoenix dactylifera	G. L.	Cur.	N. Afr. Arab.

PANDANACEAE

NAME OF PLANT	Authority	Properties	Locality
Pandanus odoratissimus L.	G.		Ind. Arab.
Pandanus Thomensis Henrig.	G.		

PAPAVERACEAE

Argemone alba Lestib.	L.	Nar.	S. U. S.
Argemone intermedia Sw.	L.	Nar.	Mex.
Argemone mexicana L.	Sm.Ches.L.	Nar.	N. Am. Tex. Mex.
Bocconia cordata Willd.	L.	Ant.	China. Japan.
Bocconia frutescens L.	G. L.	Ant.	Mex. Peru.
Chelidonium majus L.	C. Rusby G. Sm. Ches. Mi. L.	Ir. Nar.	Eur. As. N.Am.
Eschscholtzia californica Cham.	G.		Calif.
Glaucium corniculatum Curb.	L.	Pur.	Eur.
Glaucium flavum Crantz.	C. Sm. L.	Ir.	Eur. Med. Reg.
Hypecoum procumbens L.	G.		Med. Reg. Arabia.
Papaver aculeatum Thumb.	G.		S. Afr. Austr.
Papaver Rhoeas L.	G. Sm. Ches. C. L.	Ir.	Eur. Ori. Afr.
Papaver somniferum L.	C. Mi. Ches. L.	Nar.	Eur. As. Ind. N. Am.
Roemeria violacea Medic.	Sm.	Ir.	Eur. N. Afr.
Sanguinaria canadensis L.	G.Rusby L.	Ir. Em.	N. Am.
Stylophorum diphyllum Nutt.	G.		N. Am.

PASSIFLORACEAE

Andenia lobata Engl.	G.	Ant.	Trop. Afr.
Carica Papaya L.	G.		Trop. Amr.
Carica quercifolia H. St. Hil.	G.		
Carica spinosa Aubl.	G.		Braz. Guiana.
Modecca palmata Lam.	G.		Ind.
Modecca trilobata Roxb.	G.	Sap.	Ind.
Modecca venenata Forsk.	G.		
Ophiocaulon gummifera Han.	G.		Trop. Afr.
Passiflora caerulea L.	G.	Em.	Brazil.
Passiflora foetida	Sm. L.	Antisp.	
Passiflora Herbertiana Ker-Gawl.	G.		Austr.
Passiflora hispida DC.	L.	Nar.	Jamaica.
Passiflora incarnata L.	L.	Antisp.	Trop. Amer.
Passiflora laurifolia L.	G. L.	Hyd.	Trop. Amer.
Passiflora quadrangularis L.	G. L.	Nar.	Trop. Amer.
Passiflora rubra L.	G.	Nar.	W. Ind.

PHYTOLACCACEAE

Anisomeria drastica Mey.	G.		
Gallesia Scorodendron	G.	Ant.	
Petiveria alliacea L.	G. L.	Abort.	W. Ind.
Petiveria tetrandra Gomez.	G.	F. P.	Brazil.
Phytolacca abyssinica Hoffm.	G.	Sap.	Trop. & S. Afr.
Phytolacca acinosa Roxb.	G.	Del. Sap.	Him.Reg. Chin.
Phytolacca decandra L.	G. C. L. Ches.Rusby	Nar. Em. Sap.	N. Amer.

NAME OF PLANT	Authority	Properties	Locality
Phytolacca dioica	G.	Sap.	S. Amer.
Phytolacca icosandra L.	G.	Sap.	Ind.
Pircunia sp. (Phytolacca)	G.	Sap.	S. Am.
Rivina humilis	G.		Trop. Am.

PIPERACEAE

Piper Carpunya Ruiz. & Pav.	G. L.		India.
Piper darienense C. DC.	L.	Sial.	Chili & Peru.
Piper methysticum Forst.	R. E.	F. P.	Panama
Piper nigrum L.	L.	Ineb.	Pacific Is.
Piper Palmeri C. DC.	G.	Sap.	
Piper peltatum L.	L.	Diur.	Trop. Am.
Piper umbellatum L.	L.	Diur.	Cosm. Tr. Reg.

PIROLACEAE

Chimaphila maculata Pursh.	G. L.	Astr.	N. Am.
Chimaphila umbellata Nutt.	L.	Astr.	Eur. N. As. N. A.
Monotropa uniflora	Sm.		Him. Reg. Japan. N. A.
Pyrola chlorantha Sw.	L.	Astr.	Eur. N. A.
Pyrola elliptica Nutt.	L.	Astr.	N. A.
Pyrola rotundifolia L.	G. L.	Em.	N. Temp. Reg.
Pyrola minor L.	L.	Astr.	N. Temp. Reg.

PITTOSPORACEAE

Billardiera longiflora Labill.		Sap.	
Pittosporum coriaceum Ait.	G.	Sap.	Madeira Is.
Pittosporum cornifolium A. Cunn.	G.	Sap.	N. Zeal.
Pittosporum crassifolium Soland.	G.	Sap.	N. Zeal.
Pittosporum eugenioides A. Cunn.	G.	Sap.	N. Zeal.
Pittosporum ferrugineum Ait.		Sap.	Malay. Austr.
Pittosporum floribundum W. & A.	G.		Ind.
Pittosporum Huttonianum T. Kirk.	G.	Sap.	N. Zeal.
Pittosporum javanicum Bl.	G.	F. P.	Java.
Pittosporum Moorei F. v. Muell.	G.	Sap.	
Pittosporum phillyraeoides DC.	G.	Sap.	Austr.
Pittosporum rhombifolium A. Cunn.			
Pittosporum tobira Ait.	G.		Japan. China.
Pittosporum undulatum Vent.	G.	Sap.	Austr.

PLANTAGINACEAE

PLATANACEAE

Platanus occidentalis L.	G.	Hyd.	N. Am.
Platanus orientalis L.	G.	Hyd.	S. Eur. Orient.

PLUMBAGINACEAE

Armeria elongata Hoffm.	L.	Astr.	Eur.
Plumbago capensis Thunb.			
Plumbago europaea L.	L.	Em.	S. Eur. Caucas.
Plumbago rosea L.	G. L.	Nar. Acr.	Ind.
Plumbago scandens L.	G. L.	Pur.	Trop. Am.
Plumbago toxicaria Bertol.	G.		Trop. Afr.
Plumbago zeylanica L.	G.	Abort. Ir.	Tr. Old World.
Statice pectinata Ait.	G.	F. P.	Canary Is.

POLEMONIACEAE

NAME OF PLANT	Authority	Properties	Locality
Cantua buxifolia Lam.	G.		Peru
Cantua pyrifolia Juss.	G.		Peru
Cobaea scandens Cav.	G.	Sap.	Mex. Ry. Mts. N. Am.
Gilia achillaefolia Benth.	G.	Sap.	Calif.
Gilia aggregata Spreng.	G.	Sap.	N. A. Ry. Mts.
Gilia laciniata Ruiz. & Pav.	G.	Sap.	Peru. Chili.
Loeselia caerulea G. Don.	G. L.	Em.	Mex.
Phlox L.	G.		N. Am.
Polemonium boreale Adams.	G.	Sap	Siberia.
Polemonium caeruleum L.	L.	Sap.	N. Temp. Reg.
Polemonium flavum Greene	G.	Sap.	N. A. N. Mex.
Polemonium gracile Willd.	G.	Sap.	
Polemonium humile Willd.	G.	Sap.	Arct. Reg.
Polemonium panciflorum Ser. Wat.			W. N. Am.
Polemonium reptans L.	G. L.	Sap.	N. Am.

POLYGALACEAE

Krameria triandra R. & Pav.	L.	Ast.	Peru
Monnina sp. R. & P.	G.	Sap.	Trop. Am.
Polygala alba Nutt.	L.	Ir.	N. A.
Polygala amara L.	G.		Eur.
Polygala angulata DC.	G.	Sap.	Brazil.
Polygala aspalatha L.	G.		Braz.
Polygala Boykini Nutt.	L.	Ir.	N. A.
Polygala Cyparissias A. St. Hil.	G.	P.	
Polygala glandulosa HBK.	G.		Mexico.
Polygala Javana DC.	G.	Sap. Ins.	Malaga.
Polygala Senega L.	G. Sm. L.	Sap. Ir.	N. Am.
Securidaca longepeduculata Fres.	G.	P.	Abyss.

POLYGONACEAE

Fagopyrum esculentum Moench.	C.	Ir.	Eur. N. As.
Polygonum acre HBK.	R. L. E.	Ir. F. P.	Cosm.
Polygonum barbatum L.	G.	F. P.	Tr. Old World.
Polygonum Bistorta L.	C. L.	Astr.	N. Reg.
Polygonum Convolvulus L.	C.		N. Temp. Reg.
Polygonum flaccidum Meiss.	G.	Ir.	Ind. Malay.
Polygonum Hydropiper L.	G. C. L.	Ir.	Temp. Reg. N. & S.
Polygonum hydropiperoides Michx.	G.	Ir.	N. Am.
Polygonum orientale L.	G.	Ir	Tr. Old World.
Rheum Emodi Wall.	L.	Pur.	Him. Reg.
Rheum hybridum Murray	L.	Pur.	Mongolia
Rheum officinale Baill.	L.	Pur.	Thibet.
Rheum palmatum L.	Sm.	Pur.	Mong.
Rheum Rhaponticum Delarb.	L. Newspaper Death in Iowa	Pur. Astr.	Siberia.
Rumex abyssinicus Jacq.	G.	Taen.	Abyss.
Rumex Acetosa L.	L.	Astr.	Eur. N. As.
Rumex Acetosella	C. L.	Oxal. Acid	Eur. N. Am.
Rumex Crispus		Oxal. Acid	Eur. N. Am.
Rumex Ecklonianus Meiss.	G.	Taen.	S. Afr.
Rumex hymenosepalus Torr.	G. L.	Astr.	W. & S. W. N. Am.
Rumex obtusifolius L.	L.	Astr.	Eur. As. N. A.

PORTULACEAE

NAME OF PLANT	Authority	Properties	Locality
Lewisia rediviva Pursh.	G.		W.N.Am. Mont.
Talinum polyandrum Ruiz. & Pav.	G.	Acr.	Peru.

PRIMULACEAE

NAME OF PLANT	Authority	Properties	Locality
Anagallis arvensis L.	G. C. Ches. Mi. L.	Sap.	Eur. Temp. As.
Cortusa Matthioli L.	C.	Sap.	N. As.
Cyclamen europaeum L.	R. C. E. G. L.	Sap. F. P.	Eur. Cauc. Reg.
Cyclamen graecum Link.	R.	F. P.	Greece.
Cyclamen hederaefolium Ait.	G.		S. Eur.
Cyclamen latifolium Sibth. & Sm.	G.		Greece, A. Min.
Lysimachia Nummularia L.	G. L.	Astr.	Eur.
Primula Auricula L.	G.		Eur.
Primula obconica Hance.	G. L.	Ir.	China.
Primula Parryii A. Gray.	Pam.		Ry. Mts. N. A.
Primula reticulata Wall.	G.		Him. Reg.
Primula sinensis	Sm.	Ir.	China.

PROTEACEAE

NAME OF PLANT	Authority	Properties	Locality
Brabejun L.	G.	Hyd.	S. Afr.
Grevillea mimosoides R. Br.	G.		Austr.
Helicia robusta Wall.	G.	Hyd.	Him. Reg. Burma. Malay.
Knightia excelsa R. Br.	G.	Sap.	N. Zeal.
Macadamia ternifolia F. Muell.	G.	Hyd.	Austr.
Protea cynaroides L.	G.	Hyd.	S. Afr.
Roupala Pohlii Meiss.	G.		Brazil.
Roupala vervaineana Hort.	G.		Austr.
Xylomelum pyriforme Knight.	G.		Austr.

RANUNCULACEAE

NAME OF PLANT	Authority	Properties	Locality
Aconitum Anthora L.	C. L.		N. As.
Aconitum chinense Sieb.	L.		Japan.
Aconitum ferox Wall.	C. Sm. L.	F. P. Ast.	Him. Reg.
Aconitum columbianum Nutt.	Ches.		W. N. Am. Ry. Mts.
Aconitum Fischeri Reich.	L.		N. As. N. Am.
Aconitum heterophyllum Wall.	C. L.		Him. Reg.
Aconitum japonicum Decne.	L.		Japan.
Aconitum Lycoctonum L.	Mi.C.G.L.		Eur. N. As.
Aconitum Napellus L.	Mi. Rusby C.Sm. Wh. L. Ches.	Ast.	N. Temp. Reg, Eur.
Aconitum noveboracense Gray.	Rusby	Ast.	E. N. Am.
Aconitum uncinatum L.	L.		N. A. Japan.
Actaea alba (L.) Mill.	L. Rusby Ches.	Em.	N. A.
Actaea rubra (Ait.) Willd.	Rusby		N. Temp. Reg.
Actaea spicata L.	Wh. G. Sm.	Asth.	N. A.
Adonis Dill. sp.	Mi.		Eur. As.
Adonis aestivalis L.	G.	Ir.	Eur. Ori.
Adonis amurensis Regel & Radde.	G.	Ir.	Manchuria.
Adonis vernalis	C. Sm. L.	Ir.	Eur. N. Am.
Anemone altaica Fisch.	G.		Siber. Altai.
Anemone apennina L.	Mi.	Ir.	N. Am.

NAME OF PLANT	Authority	Properties	Locality
Anemone coronaria	L.	Ir.	Med. Reg. Ori.
Anemone nemorosa L.	Sm. C. G. Mi. L.	Ir.	Eur. N. As. N. Am.
Anemone parviflora Michx.	G.		N. Am.
Anemone patens L. var Wolfgangiana Koch.	Ches.Rusby	Abort. Ir.	N. Cent. St. Ry. Mts. Br. Am.
Anemone pratensis L.	C.		Eur.
Anemone Pulsatilla L.	G.C.Mi.Sm.	Abort. Ir.	Eur.
Anemone ranunculoides L.	Mi. L.	Ir.	Eur. Can. Siberia.
Anemone sylvestris L.	L.	Ir.	Eur. Cauc. Reg.
Aquilegia caerulea James.	L.	Diur.	W. N. Am.
Aquilegia canadensis L.	L.	Diur.	N. A.
Aquilegia vulgaris L.	G.C.Mi.L.	Ir.	Eur. Ori.
Caltha arctica R. Br.	Sm.	Pur.	Arct. Reg.
Caltha palustris L.	G. C. Sm.	Acr.	N. Temp. & Arct. Reg.
Cimicifuga foetida L.	C. Sm.	Acr.	Eur. Siberia.
Cimicifuga racemosa L.	G. Sm. L. Rusby	Ast.	N. Am.
Clematis aethusiaefolia Turcz.	G.	Acr.	Mong.
Clematis alpina Mill.	G. C. Sm.	Sap.	Eur. N. Am.
Clematis Bergeroni A. Lavall.	G.	Sap.	
Clematis brachiata Thunb.	G.	Ver.	S. Afr.
Clematis Buchaniana DC.	G.	Sap.	Him. Reg.
Clematis caripensis HBK.	G.	Ves.	Mex.
Clematis cirrhosa L.	G.	Sap.	Med. Reg.
Clematis Flammula L.	C. G.	Sap.	Med. Reg.
Clematis florida Thunb.	G.	Ir. Sap.	Japan.
Clematis Fremonti S. Wat.	G.	Sap. Hyd.	W. N. Am.
Clematis Gouriana Roxb.	G.	Ir.	Ind. Malay.
Clematis integrifolia L.	G. C.	Hyd.	S. Eur. N. As.
Clematis lanuginosa Lindl.	G.	Ir. Hyd.	China. W. N. Amer. Ry. Mts.
Clematis mauritiana L.	G.		Madag. Maurit Is.
Clematis orientalis L.	G.	Hyd.	Him. Reg. Ori.
Clematis Pitcheri Torr. & Gray.	G.	Sap.	E. N. Am.
Clematis pseudo-flammula Sch.	G.	Sap.	
Clematis reticulata Walt.		Sap.	N. Am.
Clematis Vitalba L.	G.Sm.C.Mi. L.	Ir.	Eur. N. Afr. Cauc.
Clematis Wightiana Wall.		Hyd.	Ind.
Clematis Williamsii Gray.	G. Sm.		Japan.
Delphinium Ajacis L.	M. G. L.	Ir.	Eur.
Delphinium Brunonianum Royle	G.	Card.	Him. Reg.
Delphinium caeruleum Jacq.	G.		Him. Reg. N. Am.
Delphinium Consolida L.	C. Mi. L. Ches.	Ast.	Eur. N. As.
Delphinium Geyeri Greene	Ches. L. Ches.	Acr.	N. A. Ry. Mts.
Delphinium Menziesii DC.	G. L. Ches.	Car	W. N. Am.
Delphinium mauritiana Coss.	G.		N. Afr.
Delphinium peregrinum L.	G.		S. Eur. Ori.
Delphinium recurvatum Greene	Ches. L. Ches.	Acr.	W. N. Am.
Delphinium Requieni DC.	C.		Med. Reg.
Delphinium scopulorum A. Gray.	L. Ches.		N. Am.

NAME OF PLANT	Authority	Properties	Locality
Delphinium Staphisagria L.	G.Sm.W.C. L.	Ast.Paras.	Med. Reg.
Delphinium tricorne Michx.	G. L. Ches.	Car.	E. N. A. S. Sts.
Delphinium trolliifolium Gray.	G. Ches.		W. N. Am.
Delphinium uncinatum Hook.	G. L.	Ir.	Him. Reg.
Eranthis hyemalis Salisb.	Sm. G.	Ast.	Eur.
Helleborus foetidus L.	C.G.Sm.L.	Pur.	Eur.
Helleborus niger L.	G.W.C.Sm. L. Mi.	Pur.	Eur.
Helleborus odorus Waldst.	Sm.		Hungary.
Helleborus orientalis Lam.	C. Sm.		A. Min. Greece.
Helleborus viridis L.	G. Ches. L.	Pur.	Eu.
Hydrastis canadensis L.	L.	Berb.	N. A.
Isopyrum fumarioides L.	G.	Hyd.	Eur. N. As.
Isopyrum thalictroides L.	G.		S. Eur.
Knowltonia vesicatoria Sims.	G. L.	Acr. Ves.	S. Afr. Cape. Reg.
Nigella damascena L.	L.	Sap.	Med. Reg.
Nigella sativa L.	G. L.	Sap.	Med. Reg.
Ranunculus abortivus L.		Ir.	E. N. Am.
Ranunculus acris L.	C.G.Sm.Mi. L.	Acr.	Eur. N. As.
Ranunculus alpestris L.		Acr.	Eur.
Ranunculus aquatilis L.	Mi. Sm.	Ir.	Tem. Reg.
Ranunculus arvensis L.	G.Sm.C.L.	Acr.	Eur. N. As.
Ranunculus, asiaticus L.	Sm.	Ir.	Asia.
Ranunculus auricomus L.	Mi. Sm. L.	Ir.	N. Temp. Reg.
Ranunculus bulbosus L.	G.C.Mi.Sm.	Ir.	Temp. Reg.
Ranunculus Ficaria L.	G.C.Sm.Mi.	Ir.	Eur. Caucas.
Ranunculus Flammula L.	G.C.Sm.Mi. Rusby	Ir.	N. Temp. Reg.
Ranunculus hybridus	G. C. Mi.	Ir.	S. Eur.
Ranunculus lanuginosus L.	G.		Eur. Cau. Reg.
Ranunculus lappaceus	Sm. M.	P.	Austr.
Ranunculus lingua L.	C. Mi.		Eur. Siber.
Ranunculus polyanthemos L.	Mi.		Cauc. Reg.
Ranunculus repens L.	C. Mi.		N. Temp Reg.
Ranunculus sceleratus L.	G. Mi. Sm. RusbyChes.	Acr. Ir.	Eu. N. Am.
Ranunculus septentrionalis Poir.	Ir.	Acr.	E. N. Am.
Ranunculus Thora L.	G. Mi. Rusby	Ves.	S. Eur.
Thalictrum flavum L.	C.		Eur. N. As.
Thalictrum foetidum L.	Sm.		Eur. Siberia
Thalictrum macrocarpum Gren.	C. G.		
Trollius asiaticus L.	G.	Sap.	Siberia.
Trollius europaeus L.	G.	Sap.	Eur. Caucas.
Trollius pumilus D. Don.	G.	Sap.	Him. Reg.
Zanthoriza	M.		Austr.

RESEDACEAE

Reseda Tourn. sp.	G.	Hyd.	Eur.
Reseda Luteola L.	L.	Diur.	Eur.

RHAMNACEAE

Ceanothus americanus L.	G. L.	Sap.	E. N. Am.
Ceanothus azureus Desf.	G.		Mex.
Ceanothus caeruleus Lag.	L.		Mex.

NAME OF PLANT	Authority	Properties	Locality
Ceanothus integerrimus Hook & Arn.	G.	Sap.	N. W. Am.
Ceanothus ovatus Desf.	G.	Sap.	N. Am.
Ceanothus thyrsiflorus Eschw.	G.	Sap.	Calif.
Ceanothus velutinus Dougl.	G. L.	Sap.	N. W. Am. Ry. Mts.
Colletia spinosa Lam.	G.	Sap.	S. Am.
Discaria serratifolia Benth. & Hook.	G.	Sap.	Chili. Pat.
Gouania Jacq. sp.	G.		
Karwinskia Humboldtiana Zucc.	G. Coult. (Mtchell)		W. N. Am. Tex.
Paliurus aculeatus Lam.	G. L.		S. Eur. W. As.
Rhamnus Alaternus L.	C.		Med. Reg. As. Minor.
Rhamnus californica Esch.	G.	Ir.	As. Min.
Rhamnus caroliniana Walt.	L.	Lax.	N. A.
Rhamnus cathartica L.	C. Sm. L.	Ir.	Eur. As. & N. Afr.
Rhamnus Frangula L.	G. C. L.	Lax.	Asia. N. Afr. Eur.
Rhamnus Purshiana DC.	L.	Lax.	N. A.
Rhamnus Wightii W. & A.	L.	Lax.	Ind.
Zizyphus Joazeira Mart.	G.	Sap.	Brazil.
Zizyphus Lotus Lam.	G.		Med. Reg.
Zizyphus sativa Gaertn.	G.		Med. Reg. Temp. As.

RHIZOPHORACEAE

Rhizophora Mangle L.	G. Sm. L.	Tan.	Tr. Shores.

ROSACEAE

Agrimonia eupatoria L.	G. L.	Ant.	N. Tem.
Brayera anthelmintica Kunth.	G. L.	Ant.	Abyss.
Cercocarpus parvifolius Nutt.	G.	Sap.	Ry. Mts. W. N. Am.
Cormus foliosa Planch.	G.	Hyd.	
Cotoneaster Rupp.	G.	Hyd.	N. Temp. Reg.
Gillenia stipulacea Nutt.	G. L.	Em.	N. Am.
Gillenia trifoliata Moench.	L. G.	Em.	N. A.
Kageneckia angustifolia D. Don.	G.	Hyd.	Chili.
Kageneckia oblonga Ruiz. & Pav.	G.	Hyd.	Chili.
Licania hypoleuca Benthm.	G.		New Gran.
Nuttallia cerasiformis T. & G.	G. L.	Amyg. Hyd.	W. N. Am.
Osteomeles arbutifolia Lindl.	G.	Hyd.	
Peraphyllum ramosissimum Nutt.	G.	Hyd.	N. W. Am.
Poterium canadense A. Gray.	G.	Em.	N. Am.
Poterium officinale A. Gray.	L.	Astr.	Eur. N. Am. N. As.
Prunus amara	Sm.	Ast.	Asia
Prunus Amygdalus Stokes.	C. G. Sm.	Hyd.	N. Afr. Eur. W. As. Orient.
Prunus Capollin Zucc..	G.	Hyd.	Mex.
Prunus caroliniana Ait.	Ches.	Hyd.	N. A.
Prunus demissa D. Dietr.	Ches.	Hyd.	Ry. Mts. W. N. Am.
Prunus domestica L.	L.	Lax.	Eur. Cauc. Reg.
Prunus Laurocerasus L.	Sm.Mi.C.L.	Hyd.	Orient.
Prunus Mahaleb L.	G.	Hyd.	S. Eur. Orient.
Prunus persica Stokes.	G. C.	Ast. Hyd.	Temp. As.

NAME OF PLANT	Authority	Properties	Locality
			Temp. Reg.
Prunus serotina Ehrh.	G. Ches.	Hyd	Eur. N. Am.
Prunus undulata Ham.	G.	Hyd.	Him. Reg.
Prunus virginiana L.	G. C. L.	Hyd.	E. N. Am.
Purshia tridentata DC.	G.	Em.	Ry. Mt. W. N. Am.
Pygeum africanum Hook.	G.	Hyd.	Tr. Afr.
Pygeum parviflorum Teijsm. & Binn.	G.	Hyd.	Java.
Pyrus L.	G.	Hyd.	N. Tem. Reg.
Pyrus Aucuparia Gaertn.	G.		Eur. N. As.
Pyrus lanata D. Don	G.		Him. Reg.
Pyrus Sorbus Gaertn.			Eur. N. Afr.
Quillaja saponaria Molina	C. L.	Sap.	Chili.
Rhodotypos herricides Sieb. and Zucc.	G.	Sap.	Spain.
Rosa canina L.	L.	Astr.	Eur. Tem. As.
Rosa gallica L.	L.	Astr.	Eur. Cauc. Reg.
Rubus chamaemorus L.	L.	Diur.	N. & Arc. Reg.
Rubus cuneifolia E. Merc.	L.	Astr.	Eur.
Rubus villosus Ait.	G. L.	Sap.Mech.	E. N. Am.
Spiraea Aruncus L.	G.	Sap.	N. Tem. Reg.
Spiraea bella Sims.	G.	Sap.	Him. Reg.
Spiraea canescens D. Don.	G.	Sap	Him. Reg.
Spiraea Filipendula L.	G.	Ant.	N. As.
Spiraea Humboldtii Hort.	G.	Sap.	?
Spiraea hypericifolia L.	L.	Astr.	Rus. Tem. As.
Spiraea japonica L.	G.	Sap.	Japan.
Spiraea laevigata L.	G.	Sap	Siberia.
Spiraea palmata Pall.	G.	Sap.	Siber. China.
Spiraea tomentosa L.	L.	Astr.	N. A.

RUBIACEAE

Asperula cynanchica L.	G.		Eur. As. Min.
Asperula odorata L.	G. L.	Cou.	Eur.
Basanacantha tetracantha Hook.	G.	F. P.	Trop. Am.
Bothriospora corymbosa Hook.	G.		S. A.
Cephaëlis toxica A. St. Hil.	G.	Dras.	Mex. S. A. Galapagos Is.
Cephalanthus occidentalis L.	G.	Sap.	E. N. A.
Chiococca P. Br. sp.	G.	Dras.	Mex. S. A.
Chiococca P. Br. sp.	L.	Dras.	Trop. Am.
Chiococca brachiata Ruiz. and Pav.	L.	Diur.	Trop. Am.
Chiococca racemosa L.	L.	Diur.	Ind.
Cinchona sp.	G Wh.	Ir. F. P	S. A.
Coffea mauritiana Lam.	G.		Mascar. Is.
Coffea odorata Forst.	G.		Amic. Is.
Coprosoma linariifolia Hook. f.	G.		N. Zea.
Coptosapelta flavescens North.	G.	A. P.	Malay.
Galium Aparine L.	L.	Diur.	N. Tem. Reg. Magellan.
Galium asprellum Mx.	L.	Cou.	N. A.
Galium triflorum Mx.	G. L.	Cou.	N. Tem. Reg. N. A. Eur.
Geophila macropoda DC.	G.	Em.	Peru.
Geophila reniformis G. Don.	G.		Peru.
Hamelia patens Jacq.	G.		Tr. Am.
Mitchella repens L.	G. L.	Sap.	E. N. Am. Jap.
Mitragyna speciosa Korth.	G.		Borneo.
Morelia senegalensis A. Rich.	G.	F. P.	Tr. Afr.

NAME OF PLANT	Authority	Properties	Locality
Mussaenda frondosa L.	G.	Sap.	Malay. Ind.
Oldenlandia senegalensis Hiern.	G.	Ant.	Ind. Tr. Afr.
Oldenlandia umbellata L.	L.	Ant.	India
Paederia foetida	Sm.		Ind. Malay.
Palicourea rigida HBK			S. Am.
Pavetta reticulata Bl.	G.	Em.	Java.
Plectronia dicocca Burck.	G.	Hyd.	
Psychotria emetica L.	L.	Em.	N. Gran.
Psychotria Ipecacnauha Stokes	G. Wh. L.	De.p Em.	Braz.
Randia aculeata L.	Sm.		W. Ind.
Randia dumetorum La.	G. L.	F. P.	Tr. Old World.
Sickungia rubra Mart.	G.	Alk.	Braz.
Spermacoce capitata Willd.	G.		Peru.
Spermacoce semierecta Roxb.	G.	Cou.	Sumatra.
Tricalypsa Sonderiana Hiern.	G.	P.	Tr. Afr.
Vangueria spinosa Roxb.	G.		Tr. As.

RUTACEAE

NAME OF PLANT	Authority	Properties	Locality
Acronychia laurifolia Bl.	G.	F. P.	Tr. As.
Casimiroa edulis L.	G. L.	Nar.	Mex.
Choisya ternata HBK.	G.	Sap.	Mex.
Citrus Aurantium L.	C.		Tr. As.
Citrus medica L.	G. Wh.	Hyd.	Tr. As.
Cusparia febrifuga H. & B.	L.	F. P.	New Gran.
Cusparia toxicaria Engl.	G.		Braz.
Evodia rutaecarpa Hook.	L.	Pur.	Him. Reg. China. Japan.
Lunasia philipinensis Planch.	G.	A. P.	Philipp.
Melicope erythrococca Benth.	G.		Austr.
Peganum antidysintericum Kostel.	L.	Astr.	S. Afr.
Peganum Harmala L.	G. C. L.	Ant.	Cent. As.
Pilocarpus sp.	G.		W. Ind. S. Am.
Pilocarpus officinalis Poehl.	L.	Diaph.	S. A.
Pilocarpus pennatifolius Lem.	Sm. Wh.	Dep. Ir.	Brazil.
Pilocarpus racemosus Vahl.	L.	Diaph.	W. Ind.
Pilocarpus spicatus A. St. Hil.	L.	Diaph.	Brazil.
Ptelea trifoliata L.	G.	Sap.	E. N. Am.
Ruta graveolens L.	G.C.Sm.L.	Abort. Ir.	S. Eur.
Ruta montana Mill.	G.	Abort.	Med. Reg. Cau.
Skimmia japonica Thunb.	G.	P.	Japan.
Thevetia Ahouai A. DC.			Braz.
Thevetia neriifolia Juss.			
Zanthoxylum alatum Roxb.	G.	F. P.	Him. Reg. Chin.
Zanthoxylum caribaeum Lam.	G.		New Grau.
Zanthoxylum Naranjillo Griseb.	G. L.	Diur.	Argent.
Zanthoxylum scandens Bl.	G.		Java.

SALICACEAE

NAME OF PLANT	Authority	Properties	Locality
Populus balsamifera L.	Halsted	Ir.	E. N. Am. Asia.

SALVADORACEAE

NAME OF PLANT	Authority	Properties	Locality
Salvadora persica L.	G.		Orient. Ind. N. Afr.

SAMYDACEAE

NAME OF PLANT	Authority	Properties	Locality
Casearia graveolens Dal.	G.	F. P.	Ind.
Casearia guineensis G. Don.	G.	F. P.	Tr. As.
Casearia tomentosa Roxb.	G.	F. P.	Tr. As. Austr.

SANTALACCEAE

Exocarpus cypressiformis R. Br.	G. M.		Austr.

SAPINDACEAE

Alectryon excelsum Gaert.	G.	Hyd.	N. Zeal.
Blighia sapida Kon.			Afr. W. Ind.
Cardiospermum Halicacabum L.	G. L.	Sap.	Tr. Reg. N. A. S. States
Cupania sp.	G.		
Cupania Pseudorhus A. Rich.	G.	F. P.	Austr.
Dittelasma Rarak DC.	G.	F. P.	Malacca
Dodonaea physocarpa Fv. Muell.	G.		Austr.
Dodonaea viscosa Jacq.	G. R.	F. P.	Cosmop. Tr.
Ganophyllum falcatum Bl.	G.	Sap.	Malacca.
Harpullia arborea Radlk.	G. R.	F. P.	
Harpullia cupanioides Roxb.	G. R.	F. P.	Ind.
Harpullia thanatophora Bl.	G.		N. Guin.
Koelreuteria paniculata Laxm.	G.		China.
Magonia glabrata A. St. H.	G. R.	Sap. F. P.	Braz.
Magonia pubescens St. Hil.	G. R. E.	Sap. F. P.	Braz.
Nephelium lappaceum L.	G.		Malay.
Nephelium Longana Camb.	G.		Ind. Burma.
Paullinia costata Schlecht.	R. G.	Sap. F. P.	Mex.
Paullinia Cupana HBK.	G. R. L.	Sap. F. P.	Venez.
Paullinia curassavica Jacq.	R.	Sap. F. P.	W. Ind.
Paullinia macrophylla Kunth.	G. R.	Sap. F. P.	N. Gran.
Paullinia meliaefolia Juss.	G.	Sap. F. P.	Braz.
Paullinia thalictrifolia Juss.	G.	Sap. F. P.	Trop. Amer.
Paullinia trigonia Vell.		Sap. F. P.	Brazil.
Sapindus abyssinicus Fres.	G.	Sap. F. P.	Abyss.
Sapindus aborescens Aubl.	G.	F. P.	Guian.
Sapindus marginatus Willd.	Sm. L.	Sap.	N. Am. S. Sts. Tex.
Sapindus Mukorossi Gaertn.	G.	F. P.	Trop. Asia
Sapindus Saponaria L.	G. L. R.	F. P.	N. & S. Am.
Sapindus trifoliatus L.	G. L.	F. P.	Trop. As.
Schleichera	G.	Hyd.	
Serjania acuminata Radlk.	G. R.	Nar.	Braz.
Serjania curassavica Radlk.	R. E.	Sap. F. P.	
Serjania cuspidata Cambess.	G.	Sap.	W. Ind.
Serjania erecta Radlk.	E. & G. R.	Sap. F. P.	Brazil.
Serjania ichthyoctona Radlk.	E. R.	Sap. F. P.	Brazil.
Serjania inebrians Radlk.	E. & G. R.	Sap. F. P.	Costa Rica.
Serjania lethalis A. St. Hil.	E. G. R. L.	Sap. F. P.	Brazil.
Serjania mexicana Willd.	L	Sap. F. P.	Mex.
Serjania nodosa Radlk.	G. R. E.	Sap. F. P.	W. Ind.
Serjania piscatoria Radlk.	E. & G. R.	Sap. F. P.	Brazil.
Serjania polyphylla Radlk.	G. R.	Sap. F. P.	Guian.
Talisia stricta Triana & Planch.	G.	Sap.	New Granad.
Ungnadia speciosa Endl.	G. L.	Sap.	Texas.

SAPOTACEAE

NAME OF PLANT	Authority	Properties	Locality
Achras sapota L.	G. L.	Sap.	S. Am.
Bassia butyracea Roxb.	G.	F. P.	Ind.
Bassia latifolia Roxb.	G.		Ind.
Bassia longifolia L.	L.	Astr.	Ind.
Bassia Mottleyana Miq.	G.	Hyd.	Malay.
Illipe Maclayana	G.		New Guin.
Lucuma Bonplandia HBK.	G.		Cuba.
Lucuma deliciosa Planch & Linden.	G.	Hyd.	New Gran.
Lucuma glycyphloca Mart.	L.	Astr.	Braz.
Lucuma mammosa Gaertn.	G.	Hyd.	S. Am.
Lucuma multiflora A. DC.	G.	Hyd.	W. In.
Lucuma salicifolia HBK	L.	Sap.	Mex.
Omphalocarpum procerum Beauv.	G.		Tr. As.
Payena latifolia Burck.	G.	Sap.	Sunda. Is.
Sideroxylon borbonicum A. DC.	G.		Barbon Is.
Sideroxylon dulcificum A. DC.	G.		Tr. Afr.
Sideroxylon toxiferum Thunb.	G.	A. P.	

SARRACENIACEAE

Sarracenia flava L.	L.	Astr.	N. A.
Sarracenia purpurea L.	G. L.	Astr.	E. N. Am.
Sarracenia variolaris Mx.	L.	Astr.	N. A.

SAURURACEAE

Saururus cernuus L.	G. L.	Sap.	E. N. Am.

SAXIFRAGACEAE

Aphanopetalum resinosum Endl.	G.	Alk.	Austr.
Callicema serratifolia Andr.	G.	Sap.	
Ceratopetalum apetalum D. Don.	G.	Cou.	Austr.
Chrysosplenium alternifolium L.	G.	Poi.	N. As. E. N. Am.
Chrysosplenium americanum Schw.		P.	N. Am.
Deutzia staminea R. Br.	G.	Sap.	Him. Reg.
Dichroa febrifuga Lour.	G.	Em.	Him. Reg.. Malay China.
Escallonia myrtilloides L. f.	G.		New Gran.
Francoa appendiculata Cav.	G.	Alk.	Chili.
Hydrangea arborescens L.	G. L.	Sap. Hyd.	N. Am.
Hydrangea Hortensia Sieb.	G.	Hyd.	Asia. Orient.
Hydrangea involucrata Sieb.		Hyd.	Japan.
Hydrangea Lindleyana	G.		
Hydrangea Thunbergii Sieb.	G.	Hyd.	Japan.
Jamesia americana Torr. & Gray.		Hyd.	Ry. Mt. N. Am.
Philadelphus coronarius L.	G.	Sap.	S. Eur.
Philadelphus grandiflorus Willd.	G.	Sap.	N. Am.
Philadelphus Lemonei	G.	Sap.	N. Am. Ry.Mts.
Philadelphus Lewisii Pursh.	G.	Sap.	
Philadelphus microphyllus A. Gray.	G.	Sap.	N. Am. N.Mex.
Ribes aureum Pursh.	G.		Ry. Mts. W. N. Am.
Ribes cereum Dougl.	G. Sm.	Intox.	W. N. Am. Ry. Mts.
Ribes macrobotrys Ruiz. & Pav.	Sm.		Peru.
Ribes nigrum L.	L.	Diur.	Eur. N. As.
Ribes prostratum L. Her.	Sm.		N. Am.

NAME OF PLANT	Authority	Properties	Locality
Saxifraga Andrewsii Harv.	G.	Sap.	
Saxifraga cortusaefolia Sieb. & Zucc.	G.	Sap.	Japan.
Saxifraga cuneifolia L.	G.	Sap.	Spain.
Saxifraga Sibthorpii Boiss.	G.	Sap.	Greece.

SCITAMINEAE

Kaempferia rotunda L.	Kirtikar		Tr. As.

SCROPULARIACEAE

Beyrichia scutellarioides Benth.	G.	Em.	Brazil.
Bonnaya veronicaefolia Spreng.	G.	Ant.	Malay. China.
Calceolaria scabiosaefolia Sims.		Em.	Peru.
Capraria biflora L.	G.		Trop. Am.
Castilleja canescens. Benth.	G.	Car.	Mex.
Chelone glabra L.	G. L.	Ant.	E. N. Am.
Digitalis ambigua Murr.	C. L.	Card.	Eur. W. As.
Digitalis lutea L.	C.		S. Eur.
Digtalis purpurea L.	G. Mi. Sm. Ches. L.	Card. Ast.	Eur. W. N.Am.
Digitalis Thapsi L.	E. G. R. C.	F. P.	Spain.
Gerardia tenuifolia Vahl	Ches.		E. N. Am.
Gratiola officinalis L.	Mi.G.C.Sm. Ches. L.	Ir.	Eur.
Gratiola peruviana L.	G.		Trop. Am. Aus. New Zeal.
Limosella aquatica L.	G.	Sap.	N. & S. Temp. Reg.
Limosella Cymbalaria Mill.	C.		Eur.
Limosella Elatine Mill.	C.		Eur. Orient
Limosella spuria Mill.	C.		Eur. N. Afr.
Linaria vulgaris Mill.	C.Sm.Mi.L. Rusby	Ir.	Eur. N. Am.
Melampyrum arvense L.	C. L.		Caucasus
Melampyrum silvaticum L.	G. L.	Diur.	Eur. N. As.
Pedicularis palustris L.	G.Mi.Ches.L.		N. Tem. & Arc. Reg.
Pedicularis sylvatica L.	Mi.		Eur.
Rhinanthus major Ehrt.	C.		Eur.
Rhinanthus minor Ehrt.	C. L.	Ins.	Eur.
Scrophularia aquatica L.	G.Sm.C.L.	Card.	Eur. Cauc.
Scrophularia nodosa L.	G Sm.C.L.	Card.	N. Temp. Reg.
Striga euphrasioides Benth.	G.	P.	India.
Vandellia crustacea Benth.	G.	Card.	Cosm. Trop.
Vandellia minuta Miq.	G.	Em.	Java.
Verbascum Blattaria L.	G.		Eur. N. As. N. Am.
Verbascum crassifolium Hoffmgg.	G.		Lusitania.
Verbascum dubium Roem & Schult.	G.		Lusitania.
Verbascum orientale Bieh.	E. R.	F. P.	Caucas.
Verbascum phlomoides L.	E. R.	F. P.	Eur. As. Min.
Verbascum pulverulentum Vill	G.		S. Eur.
Verbascum simplex Labill.	E. G. R.	F. P.	Med. Reg. Ori.
Verbascum sinuatum L.	G.		Syria.
Verbascum thapsoides L.	G.		Eur.
Verbascum Thapsus L.	E.G.R.C.L.	F. P.	Eur. N. Am. Ori. Him. Reg.

NAME OF PLANT	Authority	Properties	Locality
Veronica Beccabunga L.	L.	Diur.	N. Temp. Reg. Eur. As. Min.
Veronica officinalis L.	L.	Diur.	N. As.
Veronica virginica Nutt.	G. L. Rusby	Car. Em.	E. N. Am.

SELAGINELLACEAE

Globularia Alypum L .	G. L.	Pur.	Med. Reg.

SIMARUBACEAE

Ailanthus glandulosa Desf.	G. Rusby L.	Taen.	China.
Balanites aegyptiaca Delile.	G.	Sap.	N. Afr. Arab. Pales.
Balanites Roxburghii Planch.	G.	Sap.	Ind.
Brucea sumatrana Roxb.	G. L.		Trop. As. Aust.
Cneorum tricoccum L.	C.		S. Eur.
Picraena excelsa Lindl.	L.	Ins.	W. Ind.
Picrasma quassioides Benn.	G. L.	Ins.	Him. Reg. China
Samadera indica Gaertn.	G. L.		Ind.
Simaba Waldinii Planch.	G.		
Simaruba amara Aubl.	Sm.		Trop. Am.

SOLANACEAE

Acnistus arborescens Schlecht.	G.	Nar.	Mexico.
Anthocercis Lab. sp.	G.		Austr.
Atropa Belladonna L.	G.C.Mi.Sm. L. Rusby	Del.	Eur. Ori. Ind.
Brunfelsia Hopeana Benth.	G. L.	A. P.	Brazil.
Capsicum annuum L.	Sm. L.	Ir.	Trop. Reg. Mex. S. Am.
Capsicum frutescens L.	Sm. L.	Ir.	Tex. Mex. Trop. Reg.
Capsicum minimum Blanco.	Wh. L.	Ir.	Philipp. Is.
Cestrum aurantiacum Lindl.	Sm.	Nar.	Guatimal.
Cestrum auriculatum L'Her.	G.	Nar.	S. Am.
Cestrum macrophyllum Vent.	G.		W. Ind.
Cestrum nocturnum L.	G.		S. Am.
Cestrum pallidum Lam.	G.		Jamaica.
Cestrum Parqui L'Her.	G.		Trop. Amer.
Cestrum vespertinum L.	G.		W. Ind.
Datura arborea L.	G. C.		S. Amer.
Datura fastuosa L.	G. L.	F. P.	Tr. Old. World.
Datura ferox L.	C.		China.
Datura Metel L.	G. C. L.	Nar.	Trop. Am.
Datura meteloides DC.	L.	Nar.	W. N. A.
Datura sanguinea Riz, & Pav.	G. L.	Nar. P.	S. Am.
Datura Stramonium L.	C.G.Rusby Sm. Mi. Ches. L.	Hyp.	Cosm. Trop.
Datura suaveolens	C.	Hyp.	
Datura Tatula L.	Ches.Rusby	Hyp.	Cosm. Trop.
Duboisia Hopwoodii F. Muell.	Blyth. L.	Hyp.	Austr.
Duboisia myoporoides R. Br.	G. M. L.	Card.	Austr.
Hyoscyamus albus L.	G. L.	Hyp. Del.	Orient.

NAME OF PLANT	Authority	Properties	Locality
Hyoscyamus aureus L.	C.		A. Min. Mesop.
Hyoscyamus Falezlez Coss.	C.		W. As.
Hyoscyamus muticus L.	C. L.	Nar.	Med. Reg.?
Hyoscyamus niger L.	R.Ches.Sm. Mi. Rusby E. G. L.	Hyp. Del.	Eur. W. As. Him. Reg.
Hyoscyamus physaloides L.	G.	Hyp. Del.	Siberia.
Hyoscyamus reticulatus L.	G.	Hyp. Del.	As. Min. Egypt.
Latua venenosa Phil.	G.		Chili.
Lycium barbarum L.	G.		Orient.
Lycopersicum esculentum Mill.	G. Mi. Sm. C. L.	Sap.	S. Am. Mex. Tex. Tem. Reg.
Mandragora autumnalis Bertol.	Sm.		Med. Reg.
Mandragora officinarum L.	C. G. L.	Del.	Med. Reg.
Nicandra physaloides Gaertn.	G.	P. berry	Peru.
Nicotiana alata Link & Otto.	C.		Brazil.
Nicotoana chinensis	C.		China.
Nicotiana glauca Grab.	C. G. M.		Arg.
Nicotiana quadrivalvis Pursh.	C.		W. N. Am.
Nicotiana rustica L.	C. L.	Naus.	Mexico.
Nicotiana suaveolens Lehm.	G. M.		Australia.
Nicotiana Tabacum L.	RusbyC.R. Ches. G. L. E.	Naus. F. P.	S. Am. Temp. Reg.
Nierembergia hippomanica Mers.	G.		Arg. Rep.
Physalis Alkekengi L.	L.	Diur.	Eur. Japan.
Physalis foetens Poir.	G.	Nar.	Trop. Am.
Physalis virginiana Mill.	G.	Nar.	E. N. Am.
Physochlaina orientalis G. Don.	C. G.		Orient.
Physochlaina praealta Miers.	G.	P.	Him. Reg.
Scopolia carnicola Jacq.	C. L.	Atropin	Eur.
Scopolia japonica Max.	G. L.	Atropn Pi.	Japan.
Scopolia lurida Dun.	G.	P.	Him. Reg.
Scopolia physaloides Dunl.			Siberia. Altai.
Solandra grandiflora Sw.	G.	Alk.	Trop. Amer.
Solanum aculeatissimum Jacq.	G.		Tr. As. & Am.
Solanum aviculare Forst.	G.		Aus. & N. Zeal.
Solanum caripense Humb. & Bopl.	G.		Venez.
Solanum carolinense L.	L.	Diur.	N. A.
Solanum crispum Ruiz. & Pav.	Sm.	Del.	Chili.
Solanum Dulcamara L.	Ches. Rusby L.	Sol. Nar.	Eu. N. Am. Austr.
Solanum ellipticum R. Br.	G.		Austr.
Solanum esuriale Lindl.			Austr.
Solanum eremophilum Fv. M.	G. M.		Austr.
Solanum grandiflorum R. & P.	G.		Peru.
Solanum mammosum L.	G.		Trop. Am.
Solanum Melongena L.	C. Sm.		Tr. Old World. Austr. N. Am.
Solanum nigrum L.	G.M.Rusby C.Mi.Ches. L.	Nar.	Eur. N. Am. As.
Solanum saponaceum Dun.	G.		Peru.
Solanum sodemeum L.	G. Sm.		Trop. Old World. Calid.
Solanum Sturtianum F. v. M.	G. M.		Austrl.
Solanum stramonifolium Jacq.	G.		Cosm. Trop.
Solanum torum Sw.	G.		Cosm. Trop.

NAME OF PLANT	Authority	Properties	Locality
Solanum triflorum Nutt.	G. Ches.		W. N. Am. Ry. Mts. Neb.
Solanum tuberosum L.	M. Rusby Ches.	Sol.	S. Am. Cult. Temp. Reg.
Solanum villosum Willd.	Mi.		Eur. As. Afr.
Solanum Xanti Gray	G.		Calif.
Triguera ambrosiaca Cav.	G.		Spain.
Vestia lycioides Willd.	G.		Chili.
Withania somnifera Dun.	G.	Abort.	Med. Reg. Ori.
STERCULIACEAE			
Pterospermum diversifolium Bl.	G.	Ir.	India Malay.
Sterculia alata Roxb.	G.	Nar.	India.
TERNSTROEMIACEAE			
Camellia japonica L.	G.	F. P.	Japan, China.
Camellia Sasanqua Thunb.	G.	F. P.	Japan.
Caraipa fasiculata Cambers.	G.		Guiana.
Caryocar glabrum Pers.	G.		
Llanosia Toquian Blanco.	G.	F. P.	Pacific Isl. Guiana.
THYMELAEACEAE			
Daphne Gnidium L.	L.	Ir.	Med. Reg.
Dahpne Laureola L.	L.G.C.Mi.	Ir. F. P.	Eur. N. As.
Daphne mezereum L.	L.	Ir.	Eur. N. As.
Daphne striata Tratt.	G.		Alp. S. Eur.
Daphnopsis cestrifolia Meiss.	G.		N. Granat.
Daphnopsis Cneorum L.	G.R.Mi.E.	F. P.	Eur. Austr.
Daphnopsis Gnidium L.	G.R.C.E.	F. P. Ir.	Med. Reg.
Daphnopsis oleoides Schreb.	Brandt	Ir.	Eur. As. Min.
Dirca palustris L.	G. L.	Sap.	E. N. Am.
Edgeworthia Gardneri Meiss.	G.	F. P.	Him. Reg. Chi. Japan.
Lasiadenia rupestris Benth.	G.	P.	Guinea.
Lasiosiphon anthylloides Ness.	G.	P.	S. Afr.
Lasiosiphon eriocephalus D. C.	G.	P.	India.
Thymelaea Tartonraira All.	G.	Ir.	S. Eur.
Wikstroemia Chamaedaphne Meiss.	G.	F. P.	China.
Wikstroemia viridiflora Meiss.	G. R.	F. P.	Tr. As. Austr.
TILIACEAE			
Corchorus capsularis L.	G.		Trop. Cosm.
Echinocarpus Sigun Bl.	G.	Hyd.	Java.
Grewia asiatica L.	G. R.	F. P.	India.
Grewia bracteata Roth.		F. P.	India.
Grewia Malococca L.	G. R.	F. P.	Amicor Is.
Grewia orientalis L.	G.		Tr. As. & Aus.
Grewia pilosa Roxb.	G.		Ind. Trop. Afr.
Grewia piscatorum Hance.			China.
Prockia theaeformis Willd.	G.	F. P.	Mascar Is.
TROPAEOLACEAE			
Tropaeolum majus	Wh.	Ir.	Peru.
TYPHACEAE			
Typha latifolia L.	G.	P.	N. Temp. Reg.

ULMACEAE
UMBELLIFERAE

NAME OF PLANT	Authority	Properties	Locality
Aethusa Cynapium L.	G.C.Mi.Sm.	Ir.	Eur. Orient.
Ammi Visnaga Lam.	G. L.	Diur.	Med. Reg.
Anthriscus cerefolium Hoffm.	L.	Diur.	Eur. N. Asia.
Anthriscus sylvestris Hoffm.	L.		Eur. N. As. Can. Reg.
Anthriscus vulgaris Bern.	G. C. L.		Eur. Orient.
Apium graveolens L.	Mi. L.	Ir.	Eur. Ori. Ind. Calif.
Apium leptophyllum F. v. M.	G. M.		Austr.
Apium nodiflorum Reichb.	Sm.	Ir.	
Azorella Glebaria A. Gray.	G.	P.	
Carum capense Sond.	G.		S. Afr.
Carum copticum Benth. & Hooker.	G.		Eur. N. Afr. N. Asia.
Carum Petroselinum Benth & Hooker	C. L.	Ir.	Eur.
Caucalis daucoides L.	C.		Eur. Temp. As.
Chaerophyllum temulum L.	G.		Eur. N. Afr. Caucas. Reg.
Cicuta Bolanderi A. Gray.	Ches.	Con.	Calf.
Cicuta bulbifera L.	Rusby	Con.	N. A.
Cicuta californica A. Gray.	Rusby	Con.	Calif.
Cicuta maculata L.	Rusby G. Ches. L.	Con.	E. N. Am.
Cicuta occidentalis Greene	Ches.	Con.	W. N. Am. Ry. Mts.
Cicuta vagans Greene	G. Ches. L.	Con.	W. N. Am.
Cicuta venenata Nutt.	G.	Con.	W. N. Am.
Cicuta virosa L.	G.Sm.C.Mi. L. Rusby	Con.	Eur. N. Am.
Conium maculatum L.	L. Mi. Rusby G. Sm.Ches.C.	Dep.	Eur.Ori.N.Am.
Conopodium denudatum Koch.	G.		Eur.
Coriandrum sativum L.	G. L.		S. Eur. Ori.
Crithmum maritimum L.	G.	Ant.	Eur.
Daucus Carota L.	C. L.	Diur.	Eur. Ori.N.Am.
Elaeselinum asclepium Boiss	Sm.	Ir.	S. Eur.
Elaeselinum foetidum Boiss	Sm.	Ir.	S. Eur. N. Afr.
Ferula communis L.	G.		Med. Reg.
Ferula foetida Regel	L.	Antisp.	Turkest.
Ferula galbaniflua Boiss. & Buhse.	Wh. L.	Ir.	Persia.
Heracleum lanatum Michx.	G. L.	Acr.	Eur. N. Am. W. As.
Heracleum Spondylium L.	C. L.	Acr.	Eur. N. As.
Heteromorpha arborescens Cham. & Schl.	G.		S. Afr.
Hydrocotyle asiatica	L.	Nar.	
Hydrocotyle javanica Thunb.	G.	F. P.	Java
Hydrocotyle umbellata L.	G.	Em.	Trop. Reg.
Hydrocotyle vulgaris	Sm. Mi.		Eur.
Lichstensteinia Beiliana Eckl. & Zeyh.	G.		S. Afr.
Lichstensteinia pyrethifolia Cham. & Schlecht.	G.		S. Afr.
Molopospermum cicutarium DC.	G.	Nar.	Eur.
Oenanthe crocata L.	G. C. L.	Ir.	Eur.
Oenanthe fistulosa	C. Mi.	Ir.	Eur. Casp. Reg.
Oenanthe Lachenalii G. Gmel.	G.		Eur. Casp. Reg.

NAME OF PLANT	Authority	Properties	Locality
Oenanthe Phellandrium Lam.	G. Sm. C. L. Mi.	Ir.	Eur. N. As.
Oxypolis rigidus Britton.	Ches.		E. N. A.
Pastinaca sativa L.	C. L.	Diur.	Eur. N. A.
Peucedanum ambiguum Nutt.	G.		W. N. A.
Peucedanum foeniculaceum Nutt.	L.		W. N. A.
Peucedanum Ostruthium Koch.	L.	Acr.	Eur.
Pimpinella Saxifraga L.	L.	Naus.	Eur.
Sanicula marilandica L.	G. L.	Astr.	E. N. A.
Sium cicutaefolium Schrank.	L. Ches.		N. Tem. Reg.
Sium erectum Huds.	G. Sm. Mi.	Ir.	Eur. Cauc. Reg.
Sium latifolium L.	Mi. C. Ches.		Eur. N. A.
Thapsia garganica L.	G. L.	Ir.	Med. Reg.
Thapsia villosa L.	G.	Ir.	S. Eur.
Trachymene australis Benth.	G. M.		Austr.

URTICACEAE

Antiaris toxicaria Lesch.	Sm. L.	Ast. A. P.	Ind. Malay
Artocarpus calophylla Z. & M.		F. P.	Tennasserim
Cannabis sativa Lam.	Mi. Sm. L. Rusby	Del.	Cent. As. N. Him.Eur.N.Am.
Ficus altissima Bl.	G.		Tr.Asia, Malay
Ficus Carica L.	G. L.	Lax.	S. Eur. Orient Afr. N. & S. Am. Austr.
Ficus hispida L.	G.	P.	Trop. As. & Austr.
Ficus hypogaea.	G.		
Ficus leucantatomia Poir.	G.		Malaya
Ficus Roxburghii Wall.	Sm.	Ast.	Him. Burma
Humulus Lupulus L.	Mi. L.	Sed.	
Laportea canadensis Gaud.	Wh. L.	Ir.	N. Am.
Laportea crenulata Gaud.	L.	Ir.	Trop. As.
Laportea Gaudichaudiana Webb.	L.	Ir.	Phil. Is.
Laportea stimulans Miq.	G. L.	Ir.	Java
Trema aspera R. Br.	M.		Austr.
Urtica dioica L.	Sm. Mi. L. Ches.	Ir.	N. Temp. Reg.
Urtica gracilis Ait.	Ches. L.	Ir.	E. N. Am. Ry. Mts.
Urtica holosericea Nutt.	Pam.	Ir.	Ry. Mts. W. N. Am.
Urtica pilulifera L.	Sm. L.	Ir.	Orient. Med. Reg.
Urtica urens L.	Mi. L.	Ir.	Tem. old world

VALERIANACEAE

Valeriana dioica L.	C.		Eur.
Valeriana officinalis L.	Sm. C. L.	Ir.	Eur. N. As.

VERBENACEAE

Callicarpa americana Lam.	G.		N. Am. Tex.
Callicarpa cana L.	G.		Trop.As. Austr.
Callicarpa longifolia Lam.	G.	F. P.	Malay, Austr.
Callicarpa tomentosa Willd.	G.		China
Clerodendron infortunatum Gärt.	G.		Malay

NAME OF PLANT	Authority	Properties	Locality
Clerodendron Siphonanthus R. Br.	G.		Ind. & Malay
Duranta Plumieri Jacq.	G.	Sap.	Trop. Am.
Lantana salviaefolia Jacq.	G.		S. Afr.
Stachytarpheta indica Vahl.	G. L.	Abort.	Cosm. Trop.
Verbena hastata L.	L.	Ir.	N. A.
Verbena officinalis L.	Sm. L.	Ir.	Amphig. temp.
Verbena venosa Gill. & Hook.	Sm.	Ir.	Arg. Reg.
Vitex sp.	G.		S. Am. Afr. As. Austr.
Vitex pteropoda Miq.	G.		Malay
Vitex vestita Wall.	G.		Malay

VIOLACEAE

Anchietea salutaris St. Hil.	G. L.	Em.	Brazil
Ionidium Ipecacuanha Vent.	L.	Em.	Brazil
Noisettia HBK.	G.	Em.	S. Am.
Viola.	G.	Em.	N. Temp. Reg.
Viola odorata L.	C. L.	Em.	N. Afr. & As.
Viola pedata L.	L.	Em.	N. A.
Viola sepenicola Jord.	C.		Eur.

VITACEAE

Cissus nivea Hochst.	G.		Abyss.
Cissus pruriens Planch.	G.		
Vitis hederacea Ehr.	L.	Ir.	E. N. Am. Ry. Mts.
(Ampelopsis quinquefolia Michx.			
Psedera quinquefolia (L.) Greene)	Hals.		
Vitis elongata Wall.	G.		Ind.
Vitis Minahau.	G.		
Vitis Saponaria Seem.	G.		Austr. Pac. Is.
Vitis sessilifolia Baker.	B.		Brazil

XYRIDACEAE

Xyris communis Kunth.			Trop. Am.

ZINGIBERACEAE

Globba Beaumetzii Heck.	G.	Taen.	
Hedychium longecormatum.	G.	Ant.	
Thaunatococcus Daniellii Benth.	G.		Trop. Afr.
Zingiber officinale Rose.	Sm.	Ir.	India

ZYGOPHYLLACEAE

Guaiacum officinale L.	G. L.	Sap.	India
Larrea mexicana Moric.	G. L.	A. P.	Mex. S.W.U.S.
Nitraria tridentata Desf.	G.	Ineb.	Syria, N. Afr. & Tropics
Tribulus cistoides L.	G.		Cosm. Trop.
Tribulus maximus L.	G.	Sap.	N. Am. Guiana
Zygophyllum coccineum L.	G.		N. Am. Arab.
Zygophyllum Fabago L.	G.		Spain, N. Afr. W. Asia.
Zygophyllum iodocarpum F. v. M.	G.		Austr.

EUTHALLOPHYTA. SCHIZOPHYTA. SCHIZOMYCETES. BACTERIA.

NAME OF PLANT	Authority	Properties	Locality
Bacillus botulinus von Erm.	Jordan		N. Am. Eur.
Bacillus piscidus Sieber (i) Schum.	G.		Eur.

For other toxic species see Buchanan, Part I of this Manual.

EUTHALLOPHYTA. EUPHYCEAE. ALGAE. RHODOMELACEAE

Alsidium Helminthochortes Ktzg.	G.		Atlantic Ocean
Chondria vermicularis Hook.	G.		Atlantic Ocean
Hypnea muscaeformis	G.		Atlantic Ocean
Rhodomenia palmata Gre.	G.		Atlantic Ocean

See Parts I and II of this Manual.

EUTHALLOPHYTA. PHYCOMYCETES.

Saprolegnia sp.	G.		Cosm.

ASCOMYCETES

Helvellaceae

Gyromitra esculenta Fr.	H.		Eur. N. Am.

Hypocreaceae

Claviceps purpurea Tul.	G. Mi.	Abort.	Eur. N. Am. As. Austr.

BASIDIOMYCETES

Agaricaceae

Amanita cothurnata Atk.	A.		E. N. Am.
Amanita floccocephala Atk.	A.		E. N. Am.
Amanita Frostiana Pk.	Cl.A.H.Pk.		E. N. Am.
Amanita magnivelaris Pk.	H.		E. N. Am.
Amanita mappa Fr.	H.		E. N. Am.
Amanita muscaria L.	Cl. G. H. Farl. A. Pk. Fr. Ches. Ph.		Eur. N.Am. As.
Amanita phalloides Fr.	Cl. Pk. H. Farl.		Eur. N. Am.
Amanita recutita Fr.	A.Mi. Bull.		Eur. N. Am.
Amanita rubescens Fr.	Cl. A. Fr. Ph. Pk.		Eur. N. Am.
Amanita solitaria Bull.	Bull. Cl. A. Fr. Ph. Pk.		Eur. N. Am.
Amanita spreta Pk.	A. Pk. H.		N. Am.
Amanita strobiliformis Fr.	H. Fr. A.		Eur. N. Am.
Amanita verna Bull.	H. A.		Eur. N. Am.
Amanita virosa Fr.	Fr. H. A.		Eur. N. Am.
Cantharellus aurantiacus Fr.	G.H.A.Ph.		Eur. N. Am.
Clitocybe illudens Schw.	H. A. Cl.		N. Am.
Coprinus narcoticus Batsch.	G. Ph.		Eur.
Entoloma clypeatum (L.) Miquel.	H. Cl.		Eur. N.Am. Fr.
Entoloma graveolens Pk.	Cl.		N. Am.
Hebeloma crustuliniforme Bull.	Cl.		N. Am.

NAME OF PLANT	Authority	Properties	Locality
Hebeloma fastible Fr.	H. Cl.		Eur. N. Am.
Inocybe scaber Müll.	H.		Eur. N. Am.
Lactarius acris Bolt.	G. H.		Eur. N. Am.
Lactarius atroviridis Pk.	Pk. H.		N. Am.
Lactarius camphoratus B.	H.		Eur. N. Am.
Lactarium chrysorrheus Fr.	Fr. H.		Eur. N. Am.
Lactarius insularis Fr.	Fr. H.	Acr.	Eur. N. Am.
Lactarius pergamenus Fr.	Fr. H.	Acr.	Eur. N. Am.
Lactarius rubus Scop.	G.	Acr.	Eur. N. Am.
Lactarius scrobiculatus Fr.	Fr. H.	Acr.	Eur. N. Am.
Lactarius subdulcis Fr.	H. Fr.	Acr.	Eur. N. Am.
Lactarius torminosis Fr.	G.	Acr.	Eur. N. Am.
Lactarius trivialis Fr.	H. Fr.	Acr.	Eur. N. Am.
Lactarius turpis Fr.	Fr. H.	Acr.	Eur. N. Am.
Lactarius vellereus Fr.	Fr. H.	Acr.	Eur. N. Am.
Lactarius zonarius B.	G.	Acr.	Eur.
Lentinus suavissimus Fr.	G. Fr.		Eur.
Lentinus stypticus	G.		Eur.
Lepiota Morgani Pk.	Pk. Cl. H.		N. Am.
Marasmias oreades Bolt.	G.		Eur. N. Am.
Marasmias urens Bolt.	G. H.		Eur. N. Am.
Paneolus papilionaceus Fr.	H.		N. Am.
Pholiota caperata	Cl.		N. Am.
Pholiota radicosa B.	G.	Acr.	Eur. N. Am.
Russula Barlea L.	G.		Eur. N. Am.
Russula emetica Sch.	H.G.A.Cl.	Em.	Eur. N. Am.
Russula foetens Pers.	G. Cl.		Eur. N. Am.
Russula fragilis	H.		Eur. N. Am.
Russula rubra Fr.	G. H. Fr.		Eur. N. Am.
Stropharia aeruginosa Curt.	H.		N. Am.
Tricholoma album Schaeff.	H.	Acr.	Eur. N. Am.
Tricholoma saponaceum Fr.	Fr. Cl.	Acr.	Eur. N. Am.
Tricholoma sulphureum	Cl.	Acr.	Eur. N. Am.
Volvaria volvacea	Cl.		N. Am.
HYDNACEAE			
Hydnum amarescens L.	G.		Eur.
Hydnum graveolens	G.		Eur.
LYCOPERDACEAE			
Lycoperdon Bovista Pers.	G. Mi.		Eur. N. Am.
Lycoperdon gemmatum	Mi.		Eur. N. Am.
Lycoperdon giganteum Fr.	Fr. G.		Eur. N. Am.
Lycoperdon saururus Lam.	G.		Eur.
Scleroderma vulgare	G.		Eur. N. Am.
Secotium acuminatum	Cl.		N. Am.
PHALLACEAE			
Ithyphallus impudicus	A. Cl.		N. Am. Eur.
Lisurus borealis Burt.	H.		N. Am.
Mutinus caninus Fr.	Fr. H. Cl.		Eur. N. Am.
Mutinus elegans Mont.	H.		N. Am.
Phallus duplicatus Bosc.	H. Cl.		Eur. N. Am.
Phallus Ravenellii (B&C) E. Fisch.	H.		Eur. N. Am.
NIDULARIACEAE			
Crucibulum vulgare.	Cl.		Eur. N. Am.
Cyathus striatus	Cl.		Eur. N. Am.
Cyathus vernicosus	Cl.		Eur. N. Am.

POLYPORACEAE

NAME OF PLANT	Authority	Properties	Locality
Boletus alveolatus B. & C.	H.		N. Am.
Boletus felleus Bull.	A. H.		Eur. N. Am.
Boletus Frostii Russell	H.		N. Am.
Boletus luridus Schaeff.	M. H.		Eur. N. Am.
Boletus satanas Lenz.	H. Cl.		Eur. N. Am.
Polyporus anthelminticus Berk.	G.		Eur.
Polyporus hispidus Bull.	G.		Eur.
Polyporus squamosus Fr.	Fr. G.		Eur.

UREDINEAE

Coleosporium Sonchi-arvense (Schw.) Thunb.	Ches.	Ir.	Eur. N. Am. Austr. Cosmp.
Puccinia coronata Cda.	Pammel		Eur. N. Am. Cosmp.
Puccinia graminis Pers.	Virchow		Eur. N. Am. Cosmp.
Puccina rubigovera DC.	Pammel		Eur. N. Am. Cosmp.
Puccinia xylorrhizae	Nelson		N.Am. Ry.Mts.
Uromyces trifolii (Hedw.f) Lev	Mohler		Eur. N. Am. Cosmp.

USTILAGINACEAE

Ustilago avenae (Pers.) Jens.	Mi.	Ir.	Eur. N. Am. Cosmp.
Ustilago Hordei P) Kell. & Swingle.	Mi.	Ir.	Eur. N. Am. Cosmp.
Ustilago neglecta Niessl.	Pammel	Ir.	Eur. N. Am. Cosmp.
Ustilago nuda (Jensen) Kell. & Swingle.	Mi.	Ir.	Eur. N. Am. Cosmp.
Ustilago Tritici (Pers.) Jens.	Mi.	Ir.	Eur. N. Am. Cosmp.
Ustilago utriculosa Tul.	Pammel	Ir.	N. Am.

TILLETIACEAE

Tilletia foetens (B.&C.) Trel.	Schaffner	Ir.	N. Am. Eur.
Tilletia Tritici (Bjerk.) Wint.	Schaffner	Ir.	N. Am. Eur.

FUNGI IMPERFECTI

Cladosporium sp.	G.	Ir.	Eur. N. Am.
Diplodia zeae Lev.	E. F. Smtih	Pellagra	Eur. N. Am.
Fusarium sp.	G.	Ir.	Eur. N. Am.
Fusarium roseum Lk.	Pammel	Ir.	Eur. N. Am.
Giberella sp.	G.	Ir.	Eur. N. Am.
Macrosporium Brassicae B.	Pammel	Ir.	Eur. N. Am.
Polydesmus exitiosus Kühn.	Mohler	Ir.	Eur. N. Am.
Polythrincium trifolii Kuntze.	Pammel	Ir.	Eur. N. Am.

See Part II of this Manual for other species.

LICHENES

Cetraria juniperina Ach.	G.		Eur. N. Am.
Cetraria pinastri Ach.	G.		Eur.
Evernia vulpina Ach.	G.		Eur. N. Am.
Parmelia vulpina Ach.	G.		Eur.
Peltigera horizontalis L.	G.		Eur. N. Am.
Variolaria amara Ach.	G.		Eur.

BIBLIOGRAPHY OF POISONOUS PLANTS

By Harriette S. Kellogg

In this bibliography we have included such modern works bearing upon the subject of poisonous plants as are more easily accessible to the student, but to make this list more complete many titles of books by older writers have been added. These works are of interest not only from an historical point of view, but also from an artistic standpoint because many of them are handsomely illustrated. This is particularly true of the works of Brand and Ratzeburg, Berge and Riecke, Godet, Bulliard, Dietrich, Henry, Hegetschweiler, Otto, and Miquel which were published many years ago.

The bibliography also contains the more important articles published by the various experiment stations and by the United States Department of Agriculture besides a long list of rather recent papers appearing in technical chemical journals and in professional journals of medicine, veterinary medicine, and pharmacy. However, this bibliography is by no means complete so far as these technical journals are concerned, but from the papers indicated in the bibliography the student can easily find further literature.

Miss Kellogg has attempted to make a subject catalogue covering a great many different topics such as the sale of poisons, general treatises on poisonous plants, vegetable toxicology, poisons from Abrus, vegetable alkaloids, hydrocyanic acid, immunity, lupinosis, ricinus, poisonous seeds, geographical papers, poisons from a legal standpoint, pellagra. antidotes, etc.

While it would be impossible to indicate a reference to every species, the catalogue of the poisonous plants of the world indicates. to some extent, where the species was discussed. We have had to omit from the catalogue references to many popular treatises such as Lehmann's "Giftpflanzen mit besonderer Berücksichtigung der wirksamen Stoffe," and the works of Godet, Vicat, Henslow's "Poisonous Plants in Field and Garden" and the "Giftpflanzenbuch" by Berge and Riecke. The later as well as the earlier treatises, frequently refer to the literature where the species is mentioned as being poisonous. An example of this is found in *Helleborus niger*, Berge and Riecke give seventeen references where the plant is mentioned as poisonous; eleven references are cited in regard to Oleander, and five upon *Tecoma radicans*, showing that many of these plants have passed as poisonous for a considerable length of time.

Of peculiar and local popular treatises Germany has contributed more than any other country. The treatment of the poisonous plants in books such as Goeppert's "Ueber die Giftige Pflanzen Schlesiens," and Krause's "Studies of Poisonous Plants, in the German Colonies," aid materially in determining the distribution of certain plants. The United States has done something along this line, especially through its Department of Agriculture. The publications of Coville and Chesnut, are excellent illustrations of this. Popular accounts in such treatises as that by Miss Huntington are helpful. The subject of poison ivy probably has been treated more exhaustively than any other subject indicated. Dr. Warren has recently published a long list of papers on this subject, and he shows especially how popular impressions get into current literature without having much foundation in fact. On the subject of the anatomy very little has been published. Attention may be called to the excellent treatise of Collin, "Traite de Toxicologie Vegetale, Application du Microscope a la Recherches des Poisons. Vegetaux." 1907. The German work by Mitlacher, "Toxicologische oder forensische wichtige Pflanzen und vegetabilische Drogen, mit besonderer Berücksichtigung ihrer mikroskopischen verhältnisse", also has an admirable discussion of the subject. There are, however, many pharmocopeal treatises like the work of Flückiger (English translation "Pharmacographia"), "Pharmacognosy" by Powers, Kraemer's "Botany and Pharmacognosy", the "Organic Materia Medica" by Sayre, "Foods and Drugs" by Greenish, Tschirch and Oesterle's "Anatomischer atlas, der Pharmakognosie and Nahrungsmittelkunde," and "Microscopy of Vegetable Foods" by Winton, and the English translation of works of Moeller, which will indicate the sources from which information of this kind can be secured.

We have added some "second hand" references which have been taken from what we believe to be reliable sources. It was quite impossible to obtain all of the original papers referred to in the bibliography. Many of them, however, have been seen in the original, either by Miss Kellogg or myself.

We wish to express our thanks to Dr. Wm. Trelease of the Missouri Botanical Garden, Dr. B. L. Robinson and Dr. W. G. Farlow of Harvard University, Dr. C. S. Sargent of the Arnold Arboretum, Mr. C. G. Lloyd of the Lloyd Library, Cincinnati, to the Surgeon General of the United States Army, and Mr. Johnson Brigham of the Iowa State Library, Des Moines, for courtesies in the loan of books and papers.

L. H. Pammel.

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